F.S. R-4
RECEIVED
DEC 2 1960
TI... 39 EMENT

6/4

Have copy [illegible]

| Action | | Initial |
|---|---|---|
| | Frykman | |
| | Schmidt | |
| | Grosenbaugh | |
| | Conrad | |
| | [illegible] | |
| | Lowe | |
| | Hartong | |
| | Trostle | |
| | Melvin | |
| | TM Clerk | |
| | Survey | |
| | Open | Pass |

NOT FOR PUBLICATION
5230(4500)

# THE STATUS OF DEFOLIATOR INFESTATIONS IN FOREST SERVICE REGION 4

2 copies sent to each forest.

November 1960

By

R. I. Washburn and W. E. Cole
Entomologists

DIVISION OF FOREST INSECT RESEARCH
INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION
Reed W. Bailey, Director
Forest Service
U. S. Department of Agriculture
Ogden, Utah

TM FILE COPY

NOT FOR PUBLICATION
5230 (4500)

# THE STATUS OF DEFOLIATOR INFESTATIONS IN FOREST SERVICE REGION 4

By

R. I. Washburn and W. E. Cole
Entomologists

November 1960

## INTRODUCTION

Accelerated timber management activity in the region has created increased interest in the impact of defoliation on the timber resources of the region. This increased interest, particularly in the reproduction age class, has been reflected in reports received from and discussions held with timber managers. As a result, surveillance by forest workers has improved, and we have endeavored to improve on aerial detection surveys so that defoliator infestations can be detected as early as possible.

Early detection of defoliator infestations emphasizes the need to expand the program aimed at development and improvement of biological evaluation methods. It is much more difficult to assess the effect of a defoliator on a tree or stand with accuracy in incipient outbreaks than in large-scale epidemics.

Entomologists of the Division of Forest Insect Research inspected reported or detected infestations when conditions warranted examination, and collected data needed to evaluate the biological factors involved. These evaluations are designed to assess the effect of the infestation on the host plant, measure the insect population factors affecting its abundance and interpret this data in relation to the present and future trend of the outbreak as completely as possible. The full effect of defoliation on a host plant may not be obvious. Immediate tree mortality does not usually occur--rather cone and seed production, growth, complement of needles, and rate of assimilation may all be affected. Thus, interpretation of symptoms and predictions of future defoliation are difficult and challenging. The entomologist evaluates as completely as possible all factors present that could affect the course of an outbreak. This year some 8 defoliator species affecting 9 tree host species, plus numerous brush species within 16 different situations were evaluated. This report presents results of the evaluations of these defoliator infestations.

## SPRUCE BUDWORM

Three years have elapsed since the last large-scale budworm control project was conducted in southern Idaho. Spruce budworm remains the foremost defoliator in the area but occurs at generally lower population levels than has been observed for several years. In general, the once large, continuous, rather heavy infestations have reverted to isolated hot spots, the two exceptions being a new and increasing infestation on the Challis National Forest, and a continuing hot spot (approximately 4,000 acres) on the Targhee National Forest.

In the more accessible infestations, budworm population sampling was carried on throughout the life cycle of the insect. Biological evaluations were made during specific stages of development, i. e., immature larvae, mature larvae-pupae, and emerged pupal cases. Degree of total defoliation was recorded. In the event an infestation could not be revisited, tables developed from previous years' data were used to predict the population of the succeeding stages and/or the trend for next year. Predictions could thus be made as follows: If records in 1960 were limited to samples of immature larvae, predictions of subsequent conditions in the area were confined to relative abundance of mature larvae and probable extent of defoliation for the same year. However, if emerged pupal cases during 1960 were the sole measurement taken, forecasts were made on probable relative abundance of immature larvae in the spring and extent of defoliation during 1961.

Sequential sampling again greatly aided the evaluations. Previously, the sequential plan was used for sampling of mature larvae, pupae, and defoliation. During the past several years a plan was devised using the emerged pupal case counts. Reliable correlation was found to exist between these populations and subsequent immature larval populations upon which trend predictions for the coming year were based. In addition, reliable correlations were found to exist between larval populations in the understory and overstory which allowed hand pruning for samples instead of using the unwieldy pole pruner.

### Challis National Forest

Aerial detection surveys revealed a new, aggressive budworm infestation within the Middle Fork Salmon River and Loon Creek drainages. Portions of this infestation occur on the Boise National Forest within the Marble Creek-Mahoney Creek area. In 1957, an infestation was sprayed within these Boise River drainages and around Little Soldier Mountain on the Challis. The present infestation could have originated from the residual population following the control project, but more likely has been indigenous within the currently infested drainages.

The biological evaluation shows that within the drainages sampled (Jack Creek, Cold Spring Creek, Mahoney Creek, and East Fork Thomas Creek) defoliation averaged between 75-90 percent of the new growth. The emerged

pupal case counts indicate that at least the same amount of defoliation and larval population will occur in 1961. Parasites were at a low level except within the Mahoney Creek area. Parasite pupal cases found were those of species that attack immature budworm. Thus, even in Mahoney Creek, the budworm population, in spite of heavier populations of parasites, was large enough to cause the damage reported.

Salmon National Forest

These infestations again showed a downward trend both in size and intensity. The majority of the old infestations, i.e., Carmen Creek, Trail Creek, Deer Creek, Porphyry Creek, Jureano Mountain, Hughes Creek, suffered less than 50 percent defoliation. The larval and pupal populations are lower this year than last. Parasites again were not prevalent, but it is of interest that Itoplectis sp. was noticeable for the first time within these infestations.

Dahlonega Creek to Gibbons Pass contains the so-called hot spots. Defoliation varies greatly between trees in both of these areas. The emerged pupal case count indicates a possible decreasing trend for 1961.

An infestation in Bull Creek (Leadore area) was located during the aerial detection survey. This infestation has been present since about 1957, but only became noticeable from the air this year. Budworm populations and defoliation occur sporadically, with intensity of damage varying between trees and elevations. It is predicted that this infestation will continue at the same level in 1961, i.e, 75-90 percent defoliation.

Sawtooth National Forest

The infestation on the Sawtooth has once again receded to a relatively low level. Fleck Summit (approximately 1,000 acres) is the only area where significant populations exist. This small patch showed between 75-90 percent defoliation and it is expected that it will maintain about the same level in 1961.

Targhee National Forest

The budworm situation on the Targhee generally remained about as reported last year. The greatest expanse of infestation showed less than 50 percent defoliation. One 4,000-acre hot spot within the Targhee Creek drainage continued at a high population level with an apparent spread south and with a local increase in population within the Twin Creek drainage near Two Top Mountain. No decrease in these two areas is expected in 1961.

SUMMARY

Spruce budworm populations have decreased generally in southern Idaho with two exceptions: the Challis and Targhee National Forests. This decrease has occurred in either of two ways: the entire population within an infested area has decreased, or the larger expanses of infestations have broken up into smaller areas containing less population, with occasional hot spots and highly variable populations between trees. Only on the Targhee Forest has an older infestation shown an increasing trend and this only within an area of approximately 4,000 acres. A new and rather limited infestation is developing on the Challis National Forest.

A summary of budworm infestations by forests, acreage, and intensity of damage follows:

| Forest | Acreage | Intensity of current defoliation |
|---|---|---|
| Challis | 100,000 | light |
| | 50,000 | medium - heavy |
| Salmon | 100,000 | light - medium |
| | 15,000 | heavy |
| Sawtooth | 120,000 | light |
| | 1,000 | heavy |
| Targhee | 97,000 | light |
| | 29,500 | medium |
| | 4,000 | heavy |
| Totals | 417,000 | light |
| | 79,500 | medium |
| | 20,000 | heavy |
| | 516,500 | |

TUSSOCK MOTH

Tussock moth infestations on various plant species continue in scattered locations throughout the Intermountain area. A virus disease, occurring naturally in some areas and applied as a control measure in others, has in most cases effected some degree of control in each infestation.

Idaho City, Idaho

Approximately 50 square miles of brush species surrounding the Boise Basin Experimental Forest and the Town Creek Plantation were infested with tussock moth. The virus within the Town Creek Plantation area, reported in 1959, failed to prevent reinfestation this year. This event was not too surprising since population movement occurs in the spring during the early larval instars and reinfestation from surrounding areas is possible.

Egg masses averaged less than 1.5 per 15-inch twig. However, this is an increase of about 4:1 over last year. The greatest increase is expected to occur within the pine planting areas on the Experimental Forest. The epidemic level within Town Creek plantation is expected to continue in 1961. The infestation within this area was so intense that upon complete defoliation of the brush, the larvae began defoliating the young ponderosa pine plantings. Approximately 50 percent reduction in the population was effected by a combination of natural virus and a chemical control project. Protection of plantings may be advisable if spring examinations show high population levels.

Carson City, Nevada

This infestation occurred on bitterbrush and was included in an experimental test with a virus in 1959. The virus caused good mortality the year of treatment and apparently remained through 1960 and practically eliminated the population in the test areas.

Wheeler Peak, Nevada

Late in 1959, a tussock moth infestation on white fir, covering about 5,000 acres, was discovered on Wheeler Peak. During the winter, plans were developed to use this area for a pilot control test. The test included three virus concentrations, two replications each, applied by airplane. These concentrations were $1.25 \times 10^8$, $5.00 \times 10^8$, and $10 \times 10^8$ polyhedra per ml. per gallon, and applied at the rate of 1 gallon per acre. The formulation included corn syrup (10 percent by volume) nonchlorinated water (as the carrier) and Leucophor C (as a fluorescent tracer). Leucophor C gave excellent results in determining spray coverage.

Results of the test showed an over-all average of 62 percent reduction in the population due to virus. Higher concentrations were more effective than the lighter applications.

Highland Peak (Pioche, Nevada)

The tussock moth infestation within this white fir stand was discovered early in 1960. The insect had been at an epidemic level for 3-4 years and at the time of the spring evaluation it appeared that the epidemic tendencies would continue. However, a late fall evaluation revealed a higher than average egg parasitism and predation. Examination of mature larvae remains showed a latent virus was becoming active. These natural factors indicate the infestation will subside rather rapidly. Thus it appears that direct control will not be necessary to preserve this stand.

## SAWFLIES

### Lodgepole pine

An infestation of sawfly has been present for several years within a summer home development area near Cascade, Idaho, constituting a special value situation. Last year over 90 percent of the old-growth needles were destroyed. Cocoon counts were about the same as those observed last year but intensity of defoliation was considerably less and it may be that the infestation peaked this year. There is an apparent leveling off of the rising trend noted over the last three years.

### Douglas-fir

Sawfly infestations affecting Douglas-fir have definitely peaked this year and a downward trend is predicted. The sawfly is at an all time low within Owyhee County, Idaho, and the Sawtooth National Forest.

The sawfly epidemic within Deer Creek (Bureau of Land Management) adjacent to the Sawtooth has decreased also with defoliation dropping from greater than 90 percent to less than 25 percent. Pupal case counts were approximately half of that recorded the previous year. In addition, collections of mature larvae indicated that there was a virus occurring naturally in the populations.

### Pinyon pine sawfly

The pinyon pine sawfly, Neodiprion edulicolus Ross, near Pioche, Nevada, definitely decreased this year. During an early spring (May 4-5) inspection, heavy larval mortality was observed following unseasonal snow and freezing temperatures. Consequently, this year's defoliation was quite light and subsequent pupal density was low. In addition, a high percentage of pupae were parasitized. Parasites of the families Bombyliidae, Tachinidae, and Ichneumonidae were represented. Parasites of the genera Exenterus and Lamachus were the most prevalent. The increase in percentage of pupal parasites could be a result of the decrease in number of pupae rather than an increase in parasite numbers. This shows that although insect population reduction through physical factors is often considered temporary in nature, it may also enable biological factors to gain the advantage over the pest insect.

Noticeable defoliation is not expected next year, but inspections scheduled will be to determine if the trend continues downward as predicted.

## PANDORA MOTH

The pandora moth infestation affecting some 15,000 acres of lodgepole pine near Manila, Utah, on the Ashley National Forest, was first detected in mid-June, 1959. Biological evaluations in 1959 revealed an epidemic population of mature larvae. This insect has a two-year life cycle with mature larval feeding occurring in the odd years (1959 and 1961). This year the adults emerging from overwintering pupal stage laid eggs which produced the young larvae that fed for a short time before hibernating.

Winter rearing in the laboratory for adult emergence and egg deposition showed that little pupal mortality and continued heavy egg deposition could be expected in 1960. To verify this prediction, and to follow the insect development, four trips were made to the infestation during 1960. The pupal stage was present in the soil on July 6. At this time several hundred pupae were excavated and checked for development and survival. Four sampling areas were chosen within the main infestation and counts made as follows:

| Area | Live | Dead | Total |
|---|---|---|---|
| 1 | 124 | 69 | 193 |
| 2 | 243 | 126 | 369 |
| 3 | 33 | 11 | 44 |
| 4 | 167 | 38 | 205 |
| Total | 567 | 244 | 811 |
| Percent | 70 | 30 | 100 |

The survival figures are comparable to those obtained in the laboratory. No pupal parasites were found in the laboratory rearing or field examinations. Therefore, it was concluded that mortality was caused by disease or physiological conditions. Weather was ruled out since nearly the same mortality occurred in the laboratory. Dead specimens have been retained so determination of cause of death can be attempted this winter. Adult emergence was first observed on July 7.

The following conditions were observed July 28-29:

1. The moth flight was about complete. Thousands of moths were in flight but the majority had already mated, laid eggs, and died.

2. Only a few adult moths were observed flying more than 8' above the ground.

3. Egg deposition appeared heaviest on trees near the sunny edges of small openings in the timber stands. The apparent preferred locality for egg deposition was the lower three feet of bole with many of these eggs occurring at ground level.

4. Egg deposition also occurred on the needles and was particularly heavy on reproduction less than 6 feet high.

On July 28, large numbers of adult moths were observed in Vernal, Utah, by a Station entomologist. Vernal is approximately 35 air miles from the Manila infestation, and separated by a range of mountains over 10,000 feet in elevation. Distance and physiographic barriers seem to rule out the possibility of moth migration from the known infestation. However, a ground search on the Vernal side of the mountains did not reveal any new pandora moth infestation. Surveillance and ground detection, when mature larvae should be present, may uncover the source of the adults that were observed in Vernal.

Throughout the egg stage of the moth, bird feces was observed to contain pandora moth eggs. It appeared that at least some of these eggs were in good condition and had not suffered appreciable damage from the birds' digestive juices. If this is the case, birds could be partly responsible for spread of the moth population, especially in isolated "hot spots" that develop outside the infestation boundaries. Observation throughout the infestation showed robins, Turdus migratorius, Sub sp., were present in large numbers, so much so they proved to be a reliable aid in delineating the infestation boundaries.

Robins were shot and gut contents sampled. Well over 90 percent of the robins shot within the infestation area had been feeding on various stages of the pandora moth. Other assorted bird species were sampled and none were found to be feeding on pandora moths.

Even though large numbers of robins were feeding on the pandora moth, it is doubtful that they would effect a significant reduction in the pest population.

On September 27, larvae still had not gone into hibernation. Population density measurements averaged 6.1 immature larvae per 6-inch twig. The significance of this level cannot be determined until winter rearings and early spring evaluations are conducted. Larvae will overwinter and emerge in 1961 for the "feeding year" and if the infestation continues in 1961 at the level experienced in 1959, severe defoliation may be expected. Spring evaluations should reveal the trend and level of the larval population, and govern the decision on needs for control.

## LODGEPOLE PINE NEEDLE MINER

The lodgepole needle miner, Recurvaria milleri Busck., is an important defoliator of lodgepole pine in Region 4. In the last 4 years the needle miner has shown definite increasing tendencies. Epidemic centers now exist on four national forests in the region.

Targhee National Forest

The main infestation starts above Macks Inn, Idaho, and extends southward on both sides of the Henrys Fork for about 30 miles. Big Bend Ridge is the west boundary, some 15 miles to the east the boundary runs along a line from the southwest corner of Yellowstone National Park to Big Springs, Idaho. This infestation is located in the center of a large commercial stand of lodgepole pine and has been active approximately 4 years; severity of defoliation having increased each year. The 1960 biological survey shows a definite increase in the size of the infested area. Most of the spread has been eastward. If this eastward spread continues, the infestation will move into the Fall River Basin of Yellowstone National Park. Within this infestation, in an area from Horseshoe Lake to just west of Big Falls, defoliation was approximately 30 percent in 1959 and 1960. Defoliation was less intense in the remainder of the infestation.

Other lodgepole needle miner infestations are scattered throughout the Targhee National Forest. Some of these are within a few miles of the Sheridan Reservoir mountain pine beetle infestation. Trees weakened by lodgepole needle miner might become ideal host material for mountain pine beetle.

The Bear Gulch infestation, near Kilgore, Idaho, was detected in July 1960. This infestation is approximately 2 years old, covering 600 acres. Defoliation in 1960 exceeded 70 percent of the year-old needles. A defoliation complex is present with budworm and Dioryctria feeding on new growth and needle miner mining year-old needles of lodgepole pine. In this situation, since budworm destroys current foliage it could affect the needle miner adversely.

An infestation in McGarry Canyon, just west of Bear Gulch, was detected this year. Defoliation averaged about 50 percent in this epidemic center of about 200 acres. Budworm and Dioryctria are also present but the population densities are less than in Bear Gulch. The needle miner population in McGarry Canyon is not expected to cause appreciable tree mortality next year. The immediate threat lies in the opportunity for the infestation to spread into adjoining lodgepole drainages.

Little Cottonwood-Little Creek

East of Bear Gulch in Little Cottonwood and Little Creek, over 2,000 acres are infested with epidemic numbers of needle miner. An average of 10 percent of last year's foliage was destroyed by the needle miner this year. Budworm and Dioryctria populations exceed the needle miner population in this area.

All three of the areas north of Kilgore should be inspected frequently. We need a better idea of the effect of three pests feeding simultaneously. The relationship of defoliator feeding and susceptibility to bark beetle attack should also be determined.

Moose Creek

The Moose Creek drainage west of Victor, Idaho, contains a small infestation. Here the damage was classed as light, with about the same amount of defoliation expected next year.

Warm Creek

The small infestation north of St. Anthony, Idaho, in Warm Creek, shows defoliation was less this year than last. In addition, we believe the needle miner population shows a decreasing tendency, consequently damage should be light next year.

Caribou National Forest

This infestation of approximately 30 acres is near Grays Lake in the Eagle Creek drainage. Only 10 percent of last year's foliage was destroyed. While this population of needle miner does not presently show great increasing tendencies, it should be watched to detect any signs indicating that it might spread or increase in intensity.

Bridger National Forest

An isolated 10-acre infestation of lodgepole pine needle miner was located in the Call Creek drainage. Sixty percent of the year-old needle complement has been destroyed. The insect population may increase in intensity but not in area due to the lack of available host material.

Sawtooth National Forest

The infestation near Bald Mountain, Trapper Peak, and Pike Mountain on the Cassia Division, remains static in size and numbers. Some 22,000 acres of lodgepole pine are affected. Defoliation averaged 10-25 percent of the year-old needles. Unfortunately, the inspection of this infestation was made during adult moth stage, consequently, we have no base upon which to estimate trend of the infestation. Additional surveys will be made next year.

## FIR NEEDLE MINER

In 1957, a serious outbreak of fir needle miner, Epinotia meritana Hein., in Bryce Canyon National Park and parts of the Dixie National Forest was brought under control by aerial application of Malathion, plus a heavy degree of parasitism.

The needle miner has remained at a low level since. However, careful examination in Bryce Canyon National Park this year revealed that a decided increase in needle miner population was occurring. The population present in 1960 is considerably below that required to inflict noticeable damage. However, this increase constitutes a warning that the fir needle miner may build to epidemic level in the next few years.

## ASPEN LEAF MINER

Populations of aspen leaf miner, (Phyllocnistis populiella Chamb.), have been present in Region 4 for the past 10-13 years and are continuing to inflict heavy damage to aspen stands.

Epidemic conditions exist over most of Grand Teton National Park, and the Targhee, Teton, and Bridger National Forests. As a result of repeated yearly defoliation, mortality to aspen stands is becoming increasingly evident. The insect has a one-year life cycle and damage is caused by larvae mining the leaves from early spring to mid-July. Pupation takes place at the end of larval mines where the larvae rolls the edge of the leaf and spins a small white cocoon. Adult emergence occurs in August and the small moths can be found on conifers and grasses which offer protection from the wind. Egg deposition is assumed to be on the terminal buds of the host tree.

This year, as in 1959, predators, parasites, and other biological control agents do not appear to be holding aspen leaf miner populations in check. At the present time, no known chemical control methods have been developed to suppress large-scale infestations.

## SPRUCE MEALYBUG

The spruce mealybug, Puto sp., infestations are still active within Engelmann spruce stands in southern Utah. These infestations occur in three widely separated areas totalling approximately 60,000 acres: Barney Top, and Griffin Springs on the Dixie National Forest; and Thousand Lake Mountain near Loa, Utah, on the Fishlake National Forest. The mealybugs were first reported on the Fishlake National Forest in 1939 and on the Dixie National Forest in 1955.

This insect has a 4-year life cycle, thus the insect stages, and particularly the year of infestation, will refer to the year within the life cycle and not necessarily to the actual duration of the infestation.

Epidemic populations of young first-year melaybugs occurred this year on Barney Top and on the south end of Thousand Lake Mountain. The vigorous feeding of the second year mealybugs, near Griffin Springs and on the north end of Thousand Lake Mountain, resulted in such a copious flow of sap from the spruce needles that limb damage was easily detected. Many of the infested needles turn a bright yellow and later drop. Thus weakened, the limb eventually dies and turns black. The second-year mealybugs are the most active feeders. Subsequently, limb mortality should be prevalent within the Barney Top and south side of Thousand Lake Mountain areas next year.

Mortality of spruce reproduction is occurring within the older infestations. Some tree mortality may occur in 1962 on Barney Top and Griffin Springs as our records show large mealybug populations cause tree mortality in

about 7 years. The annual ground detection survey showed no appreciable increase in size of infested areas. On the other hand, no decrease in severity of damage occurred.

The prediction of the duration of these epidemics and the assessment of damage to population density is greatly hindered due to the lack of sampling methods.

Sufficient information is now available on the life cycle to provide the background necessary to begin work on population and damage measurements.

No practical methods are known for controlling or reducing the mealybug population in high altitude spruce stands.

## MEALYBUG

The infestation of mealybugs in true firs on the Payette National Forest continues around both Hazard Lake and Elk Lake. The infestation around Hazard Lake was discovered in 1958 and showed a high level population. In 1959, practically no mealybugs were evident in this area, but some 10 air miles west, around Elk Lake, a new infestation was discovered. In each area egg masses were sampled in August 1958 and September 1959; adults and egg masses in July 1959. In September 1960 only adults were present to sample. Possibly the sample was taken too early for egg mass data, and it was impossible to estimate trend.

## DISCUSSION

In 1960, there was again a diverse set of defoliator problems. Evaluations of these infestations included relative abundance of populations, effects of the biotic agents, and the real and potential damage to the host tree and stand. Detailed biological data collected for evaluation purposes have not been included in this report; instead we have reported our conclusions, drawn from this data, analyzed in the most acceptable manner, and tempered by our best entomological judgment.

Damage generally consisted of growth loss, although tree mortality could be a real threat in limited areas.

Because of the decreasing trend of most defoliation species, the need for direct control in 1961 is slight. Spraying of budworm could be justified on the Challis and Targhee National Forests if small unit treatment was considered. Extensive mortality will probably not occur, particularly in the overstory. However, limited mortality of reproduction could occur on the Targhee.

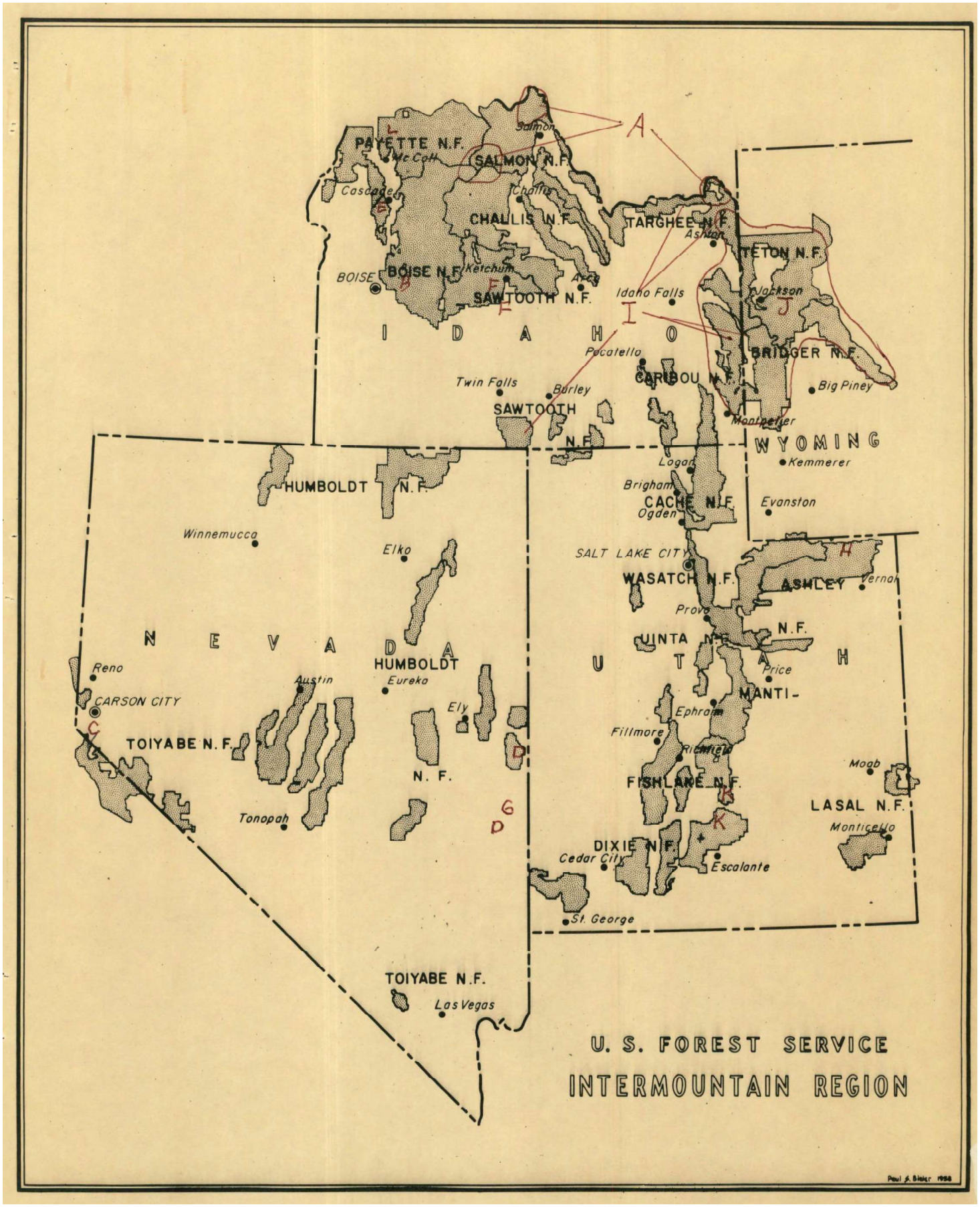
The tussock moth infestation within Town Creek and Experimental Forest plantings should receive close attention. If the populations appear to be increasing to the extent that defoliation of the ponderosa pine is imminent then control may be necessary to prevent serious loss of these young trees.

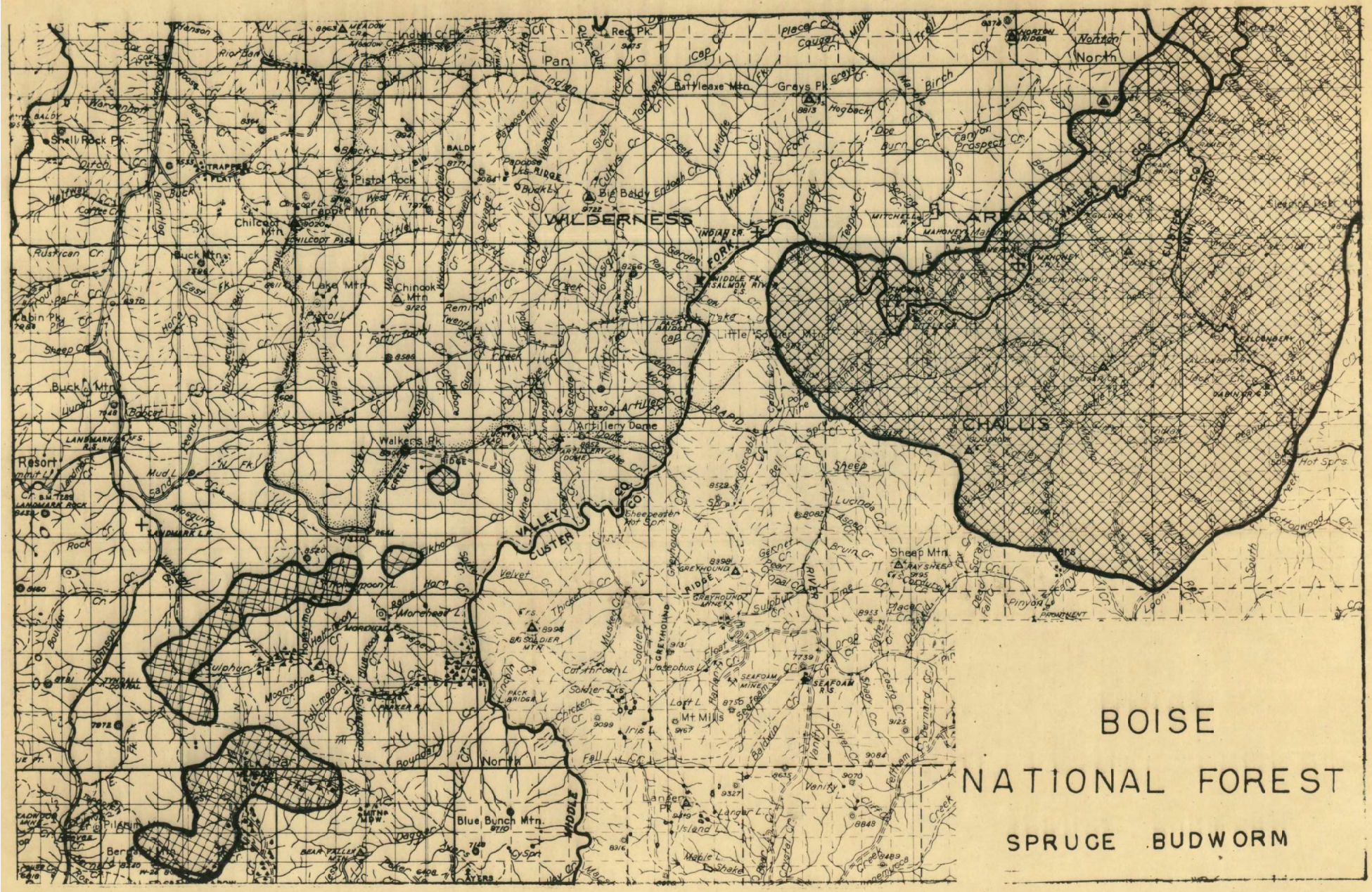
The pandora moth infestation in 1960 showed little defoliation since larval populations appeared late in the summer and are overwintering as small larvae. In 1961, these larvae will emerge for the "feeding year" and severe defoliation may be expected if the population continues at as high level as in 1959. Spring evaluations of these populations may reveal the need for control in 1961.

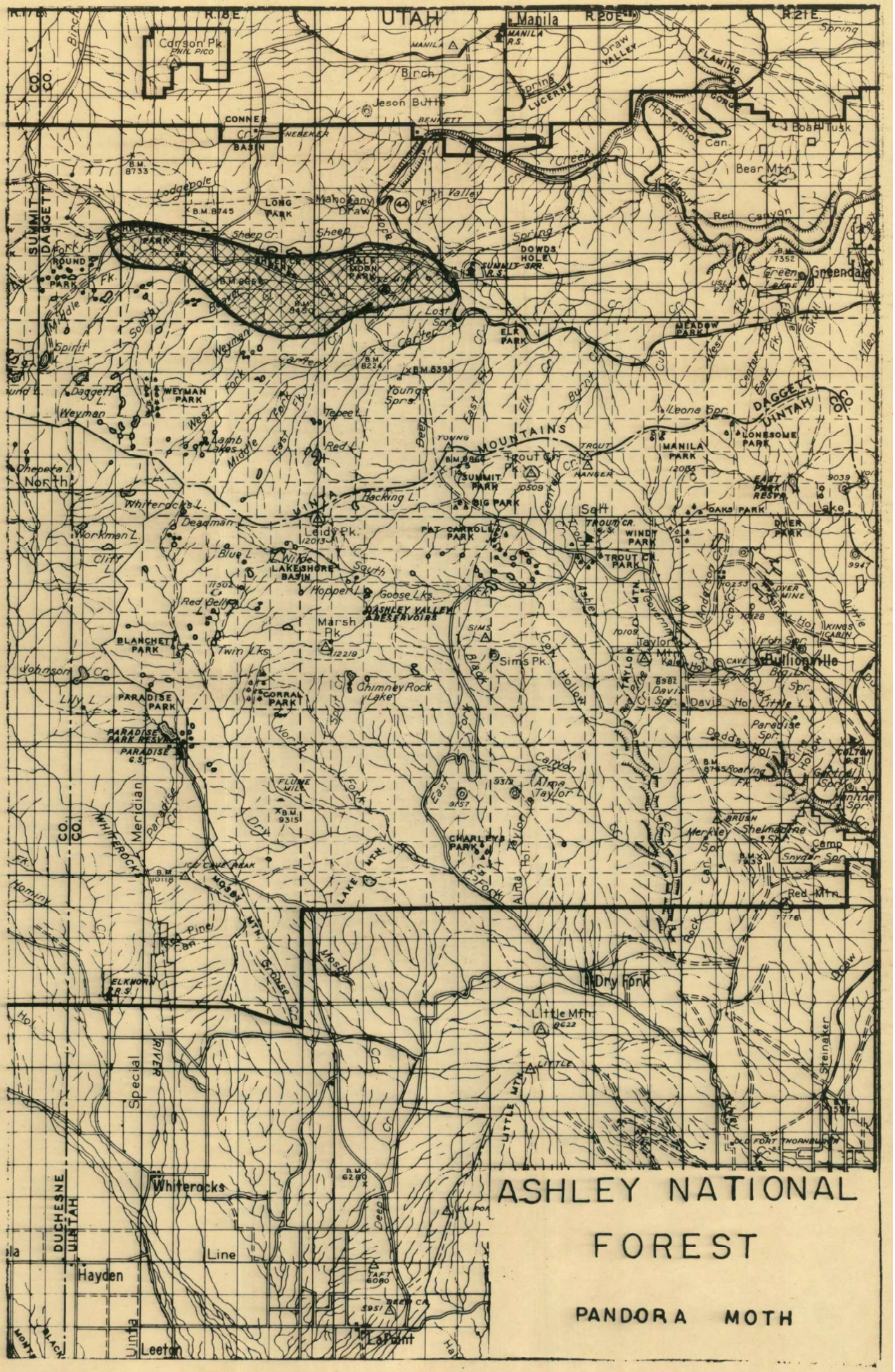
All known outbreaks, and particularly those with the greatest potential, will be closely observed to judge the validity of the predicted trends.

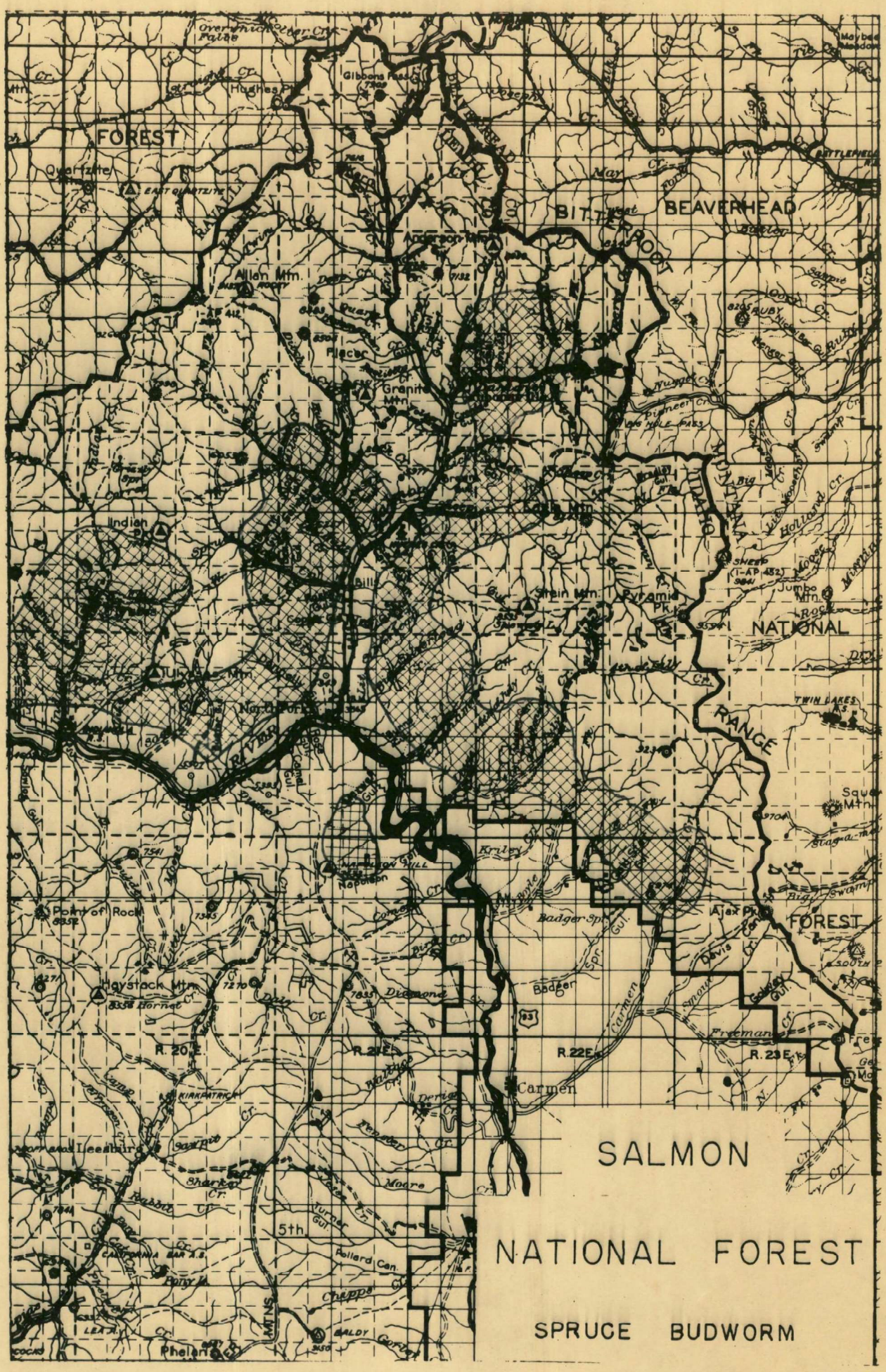
## KEY TO DEFOLIATOR INFESTATIONS

| | Insect | Host |
|---|---|---|
| A | Spruce budworm | Douglas-fir, true fir, Engelmann spruce |
| B | Tussock moth | Ceanothus |
| C | | Bitterbrush |
| D | | White fir |
| E | Sawflies | Lodgepole pine |
| F | | Douglas-fir |
| G | | Pinyon pine |
| H | Pandora moth | Lodgepole pine |
| I | Lodgepole needle miner | Lodgepole pine |
| J | Aspen leaf miner | Aspen |
| K | Mealybug, Puto sp. | Engelmann spruce |
| L | Mealybug | Firs - pine - spruce |


PAYETTE N.F.
SALMON N.F.
CHALLIS N.F.
TARGHEE N.F.
TETON N.F.
BOISE N.F.
SAWTOOTH N.F.
BRIDGER N.F.
CARIBOU N.F.
SAWTOOTH N.F.
HUMBOLDT N.F.
CACHE N.F.
WASATCH N.F.
ASHLEY N.F.
UINTA N.F.
HUMBOLDT N.F.
TOIYABE N.F.
FISHLAKE N.F.
LASAL N.F.
DIXIE N.F.
TOIYABE N.F.
Salmon
McCall
Cascade
Challis
Ashton
Ketchum
BOISE
Idaho Falls
Jackson
Pocatello
Twin Falls
Burley
Big Piney
Montpelier
WYOMING
Kemmerer
Logan
Brigham
Ogden
Evanston
Winnemucca
Elko
SALT LAKE CITY
Vernal
Provo
Reno
Austin
Eureka
Price
CARSON CITY
Ely
Ephraim
Manti-
Fillmore
Richfield
Moab
Tonopah
Cedar City
Escalante
Monticello
St. George
Las Vegas
NEVADA
UTAH
A
B
C
D
E
F
G
H
I
J
K
U. S. FOREST SERVICE
INTERMOUNTAIN REGION
Paul A. Bisler 1958

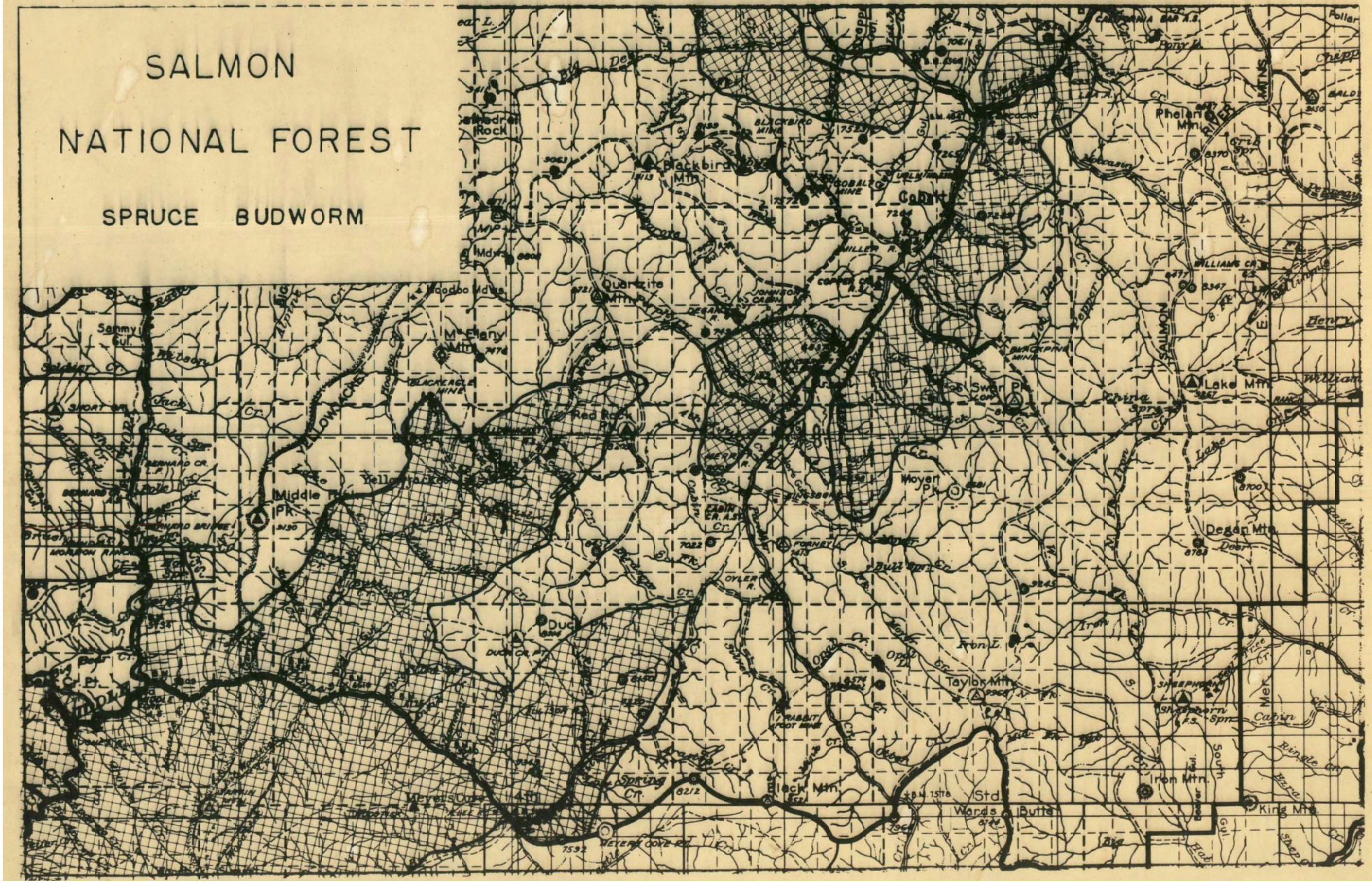

BOISE
NATIONAL FOREST
SPRUCE BUDWORM
WILDERNESS
AREA
CHALLIS
Shell Rock Pk.
Pistol Rock
Chilcoot Mtn.
Lake Mtn.
Chinook Mtn.
Buck Mtn.
Cabin Pk.
Resort
Walkers Pk.
Artillery Dome
Big Baldy
Battleaxe Mtn.
Grays Pk.
Red Pk.
Norton
North
Sheep Mtn.
Blue Bunch Mtn.
Middle Fk. Salmon R.
Middle Fork
Middle
Valley
Custer
Rapid
Sheep
Bruin Cr.
Velvet
Thicket
Sulphur
Moonshine
Boulder
Rock
Bear
Fall
Pinyon
Loon
Dead Fall
Hot Spgs.
Corral Wood
Lucinda Cr.
Sheepeater Hot Spgs.
Big Soldier Mtn.
Greyhound Mtn.
Greyhound Ridge
Mt. Mills
Seafoam Mine
Seafoam R.S.
Pack Bridge
Soldier Lks.
Iris
Josephus L.
Cottonpost L.
Landmark R.S.
Landmark L.S.
Landmark Rock
Morehead L.
Sulphur Cr.
Moonshine Cr.
Mud L.
Sand L.
Honeymoon L.
Lanes Pk.
Langer L.
Island
Vanity
Vanity L.
Cliff Cr.
Mable L.
Bear Valley Mtn.
Pilgrim
Bernard
Dagger
Cyspa
Ayers
Indian Cr.
Meadow Cr.
Riordan
Trapper Cr.
Trapper Peak
Trapper Flat
Baldy
Papoose Lks.
Papoose Ridge
Acuities
Big Baldy Entrance
Indian Ridge
Tohobit
Stink Cr.
Middle Fork
Mahoney
Mahoney Cr.
Mitchell R.S.
Indian Cr. R.S.
Garden Cr.
Tepee Cr.
Elevator Peak
Falconberry
Cabin R.S.
Hogback
Canyon Prospect Cr.
Doe Burn Cr.
Placer Cr.
Gauger Cr.
Norton Ridge
Birch
Rustican Cr.
Buck Cr.
Lake Cr.
Pistol Cr.
Remington
Twenty
Thirty-eight
Gun
Lucky
Mine Cattle
Greyhound
Bell
Sheep
Lucinda
Bruin
Sheep Mtn.
Gerret
Pearl
Opal
Sulphur
Thicket
Velvet
Moonshine
Boulder
Rock
Bear
Fall
Pinyon
Loon
Dead Fall
Hot Spgs.
Corral Wood
Soldier
Josephus
Cottonpost L.
Seafoam
Iris
Chicken
Pack Bridge
Soldier Lks.
Mt. Mills
Lanes Pk.
Langer L.
Island
Vanity
Vanity L.
Cliff Cr.
Mable L.
Bear Valley Mtn.
Pilgrim
Bernard
Dagger
Cyspa
Ayers
Blue Bunch Mtn.
Middle
North
Fall
Boulder
Sulphur
Moonshine
Honeymoon L.
Morehead L.
Landmark L.S.
Landmark Rock
Landmark R.S.
Resort
Mud L.
Sand L.
Walkers Pk.
Artillery Dome
Big Baldy
Battleaxe Mtn.
Grays Pk.
Red Pk.
Norton
North
Sheep Mtn.
Blue Bunch Mtn.
Middle Fk. Salmon R.
Middle Fork
Middle
Valley
Custer
Rapid
Sheep
Bruin Cr.
Velvet
Thicket
Sulphur
Moonshine
Boulder
Rock
Bear
Fall
Pinyon
Loon
Dead Fall
Hot Spgs.
Corral Wood
Lucinda Cr.
Sheepeater Hot Spgs.
Big Soldier Mtn.
Greyhound Mtn.
Greyhound Ridge
Mt. Mills
Seafoam Mine
Seafoam R.S.
Pack Bridge
Soldier Lks.
Iris
Josephus L.
Cottonpost L.
Landmark R.S.
Landmark L.S.
Landmark Rock
Morehead L.
Sulphur Cr.
Moonshine Cr.
Mud L.
Sand L.
Honeymoon L.
Lanes Pk.
Langer L.
Island
Vanity
Vanity L.
Cliff Cr.
Mable L.
Bear Valley Mtn.
Pilgrim
Bernard
Dagger
Cyspa
Ayers
Indian Cr.
Meadow Cr.
Riordan
Trapper Cr.
Trapper Peak
Trapper Flat
Baldy
Papoose Lks.
Papoose Ridge
Acuities
Big Baldy Entrance
Indian Ridge
Tohobit
Stink Cr.
Middle Fork
Mahoney
Mahoney Cr.
Mitchell R.S.
Indian Cr. R.S.
Garden Cr.
Tepee Cr.
Elevator Peak
Falconberry
Cabin R.S.
Hogback
Canyon Prospect Cr.
Doe Burn Cr.
Placer Cr.
Gauger Cr.
Norton Ridge
Birch
Rustican Cr.
Buck Cr.
Lake Cr.
Pistol Cr.
Remington
Twenty
Thirty-eight
Gun
Lucky
Mine Cattle
Greyhound
Bell
Sheep
Lucinda
Bruin
Sheep Mtn.
Gerret
Pearl
Opal
Sulphur
Thicket
Velvet
Moonshine
Boulder
Rock
Bear
Fall
Pinyon
Loon
Dead Fall
Hot Spgs.
Corral Wood

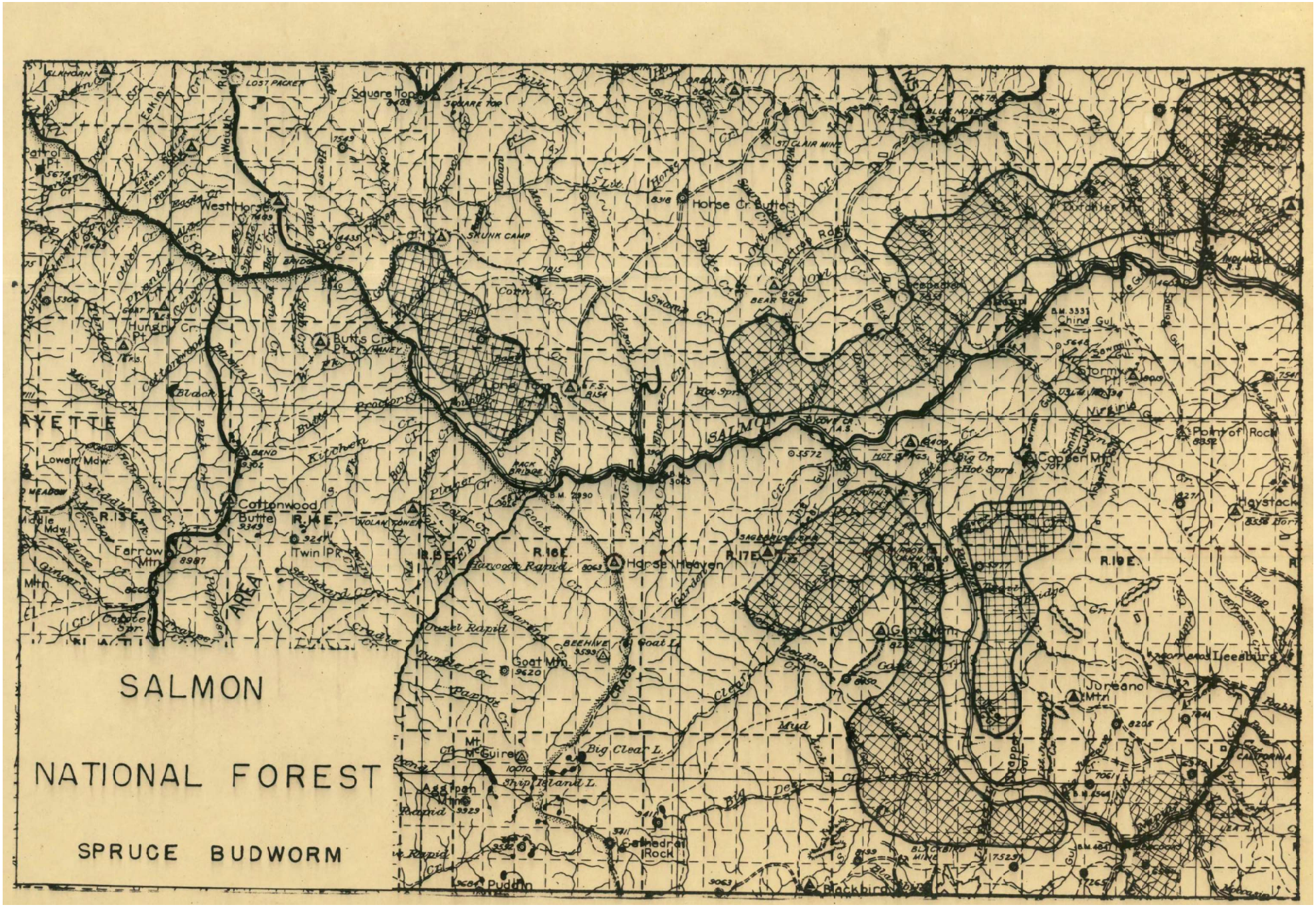

ASHLEY NATIONAL FOREST
PANDORA MOTH
UTAH
Manila
Corson Pk.
Jesson Butte
Bear Mtn.
Red Canyon
Greendale
Lodgepole
Sheep Cr.
Mahogany Draw
Death Valley
Dowds Hole
Summit Spr.
Elk Park
Meadow Park
Daggett
Uintah
Co.
Co.
Weyman
Lamb Lakes
Mountains
Manila Park
Lonesome Park
Trout Cr. Park
Summit Park
Big Park
Oaks Park
Pat Carroll Park
Windy Park
Dyer Park
Leidy Pk.
Whiterocks L.
Deadman
Workman L.
Blue L.
Cliff L.
Hopper L.
Goose Lks.
Ashley Valley Reservoirs
Marsh Pk.
Twin Lks.
Blanchet Park
Johnson Cr.
Lily L.
Paradise Park
Paradise Park Reserve
Corral Park
Chimney Rock Lake
Sims Pk.
Taylor Mtn.
Bullionville
Davis Spr.
Paradise Spr.
Dodds Hol.
Colton
Garfield
Brush
Shelmadine Spr.
Camp Snyder Spr.
Red Mtn.
Charleys Park
Alma Taylor L.
Whiterocks Meridian
Whiterocks
Dry Fork
Little Mtn.
Hayden
Line
Leeton
Duchesne
Uintah
Special River
Steinaker
Old Fort Thornburgh


FOREST
BEAVERHEAD
NATIONAL
FOREST
SALMON
NATIONAL FOREST
SPRUCE BUDWORM
Allan Mtn.
Granite Mtn.
Indian Pk.
Pyramid Pk.
Jumbo Mtn.
Haystack Mtn.
Point of Rock
Napoleon Hill
Ajax Pk.
Carmen
R. 20 E.
R. 21 E.
R. 22 E.
R. 23 E.
Phelan
Badger
Davis
Freeman
Moore
Hollard Can.
Chappo
5th

# SALMON NATIONAL FOREST

## SPRUCE BUDWORM



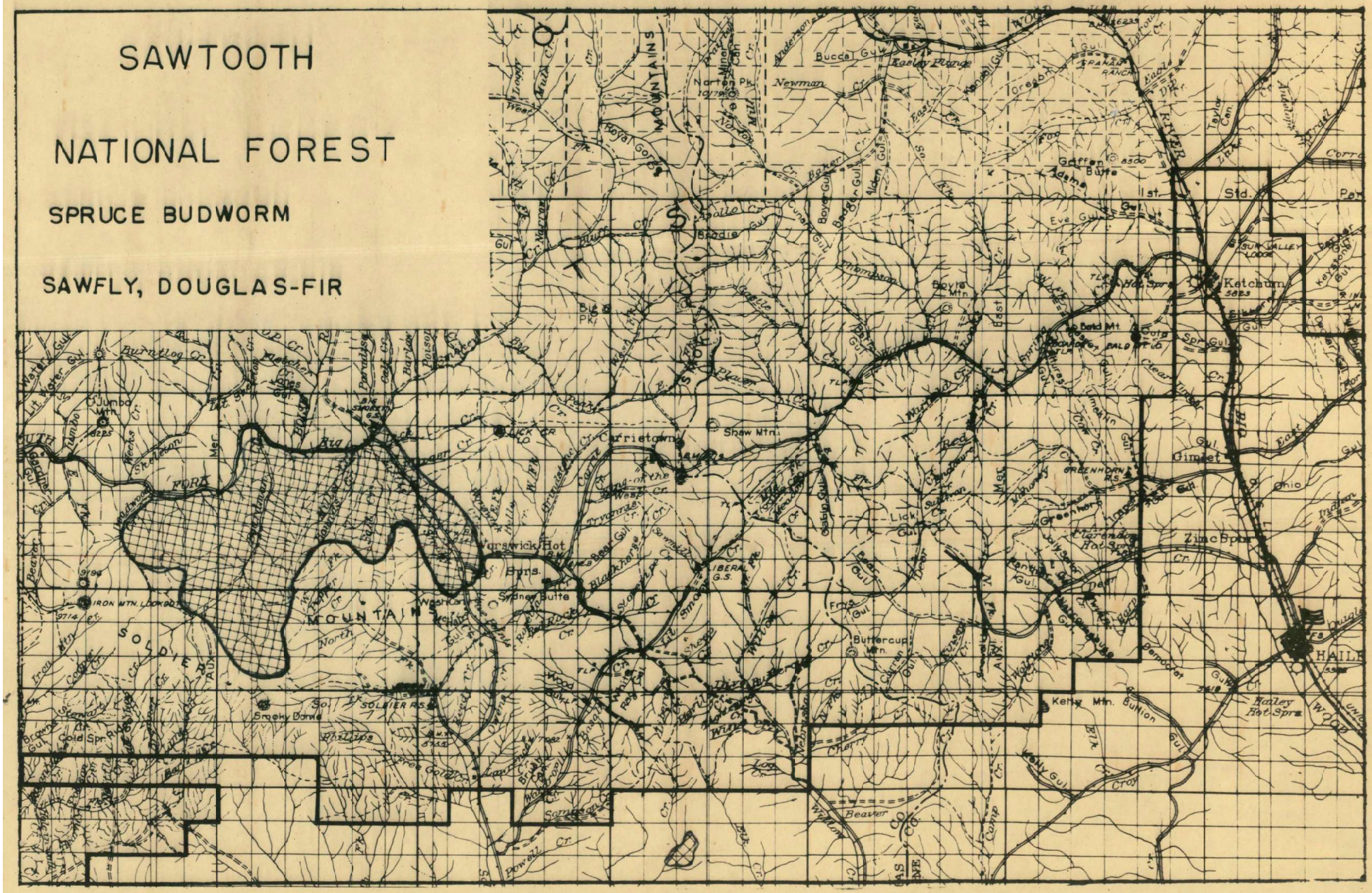

SALMON
NATIONAL FOREST
SPRUCE BUDWORM
AREA
Square Top
Horse Cr Butte
Horse Heaven
Cottonwood Butte
Goat Mtn
Big Clear L.
Mt McGuire
Cathedral Rock
Blackbird
Jureano Mtn
Leesburg
Point of Rock
Haystack
Copper Mtn
Storm Pt
Burnt Cr Pk
West Horse
Farrow Mtn
Twin IPR
Beehive
Ship Island L.
Harlock Rapid
Dexel Rapid
Rapid Cr
Pudding
R.15E.
R.16E.
R.17E.
R.18E.
R.19E.

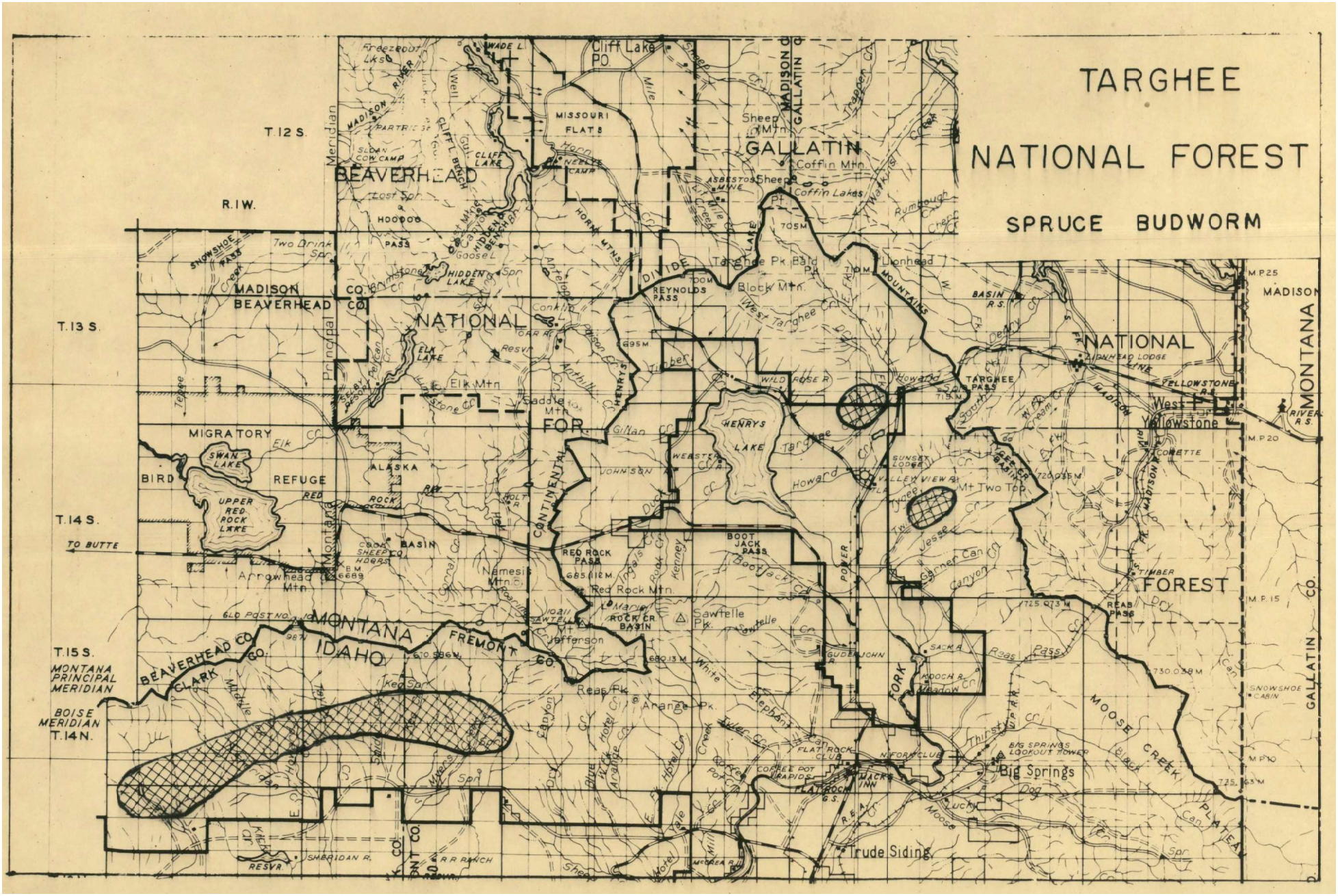
# SAWTOOTH

# NATIONAL FOREST

## SPRUCE BUDWORM

## SAWFLY, DOUGLAS-FIR

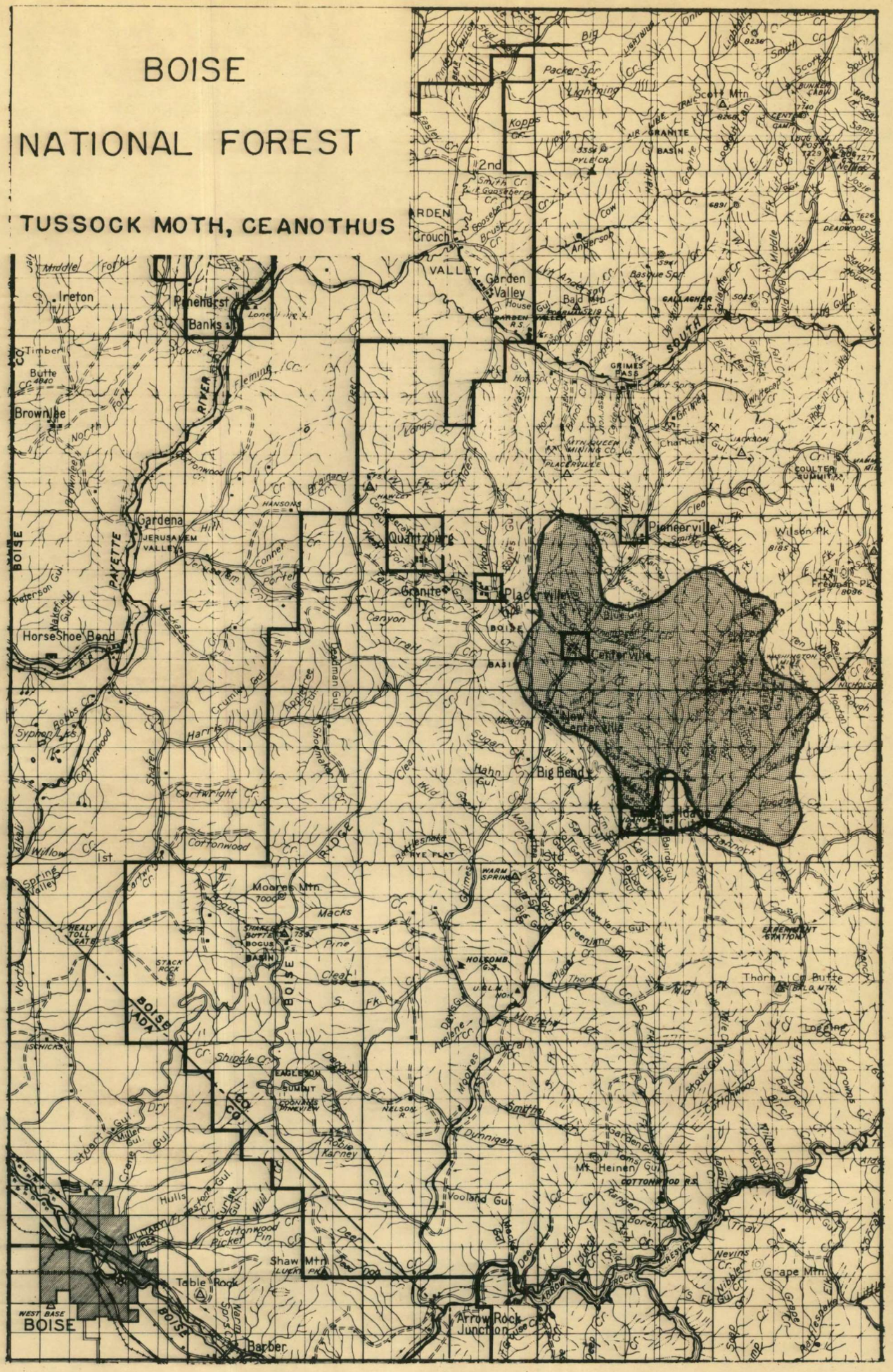


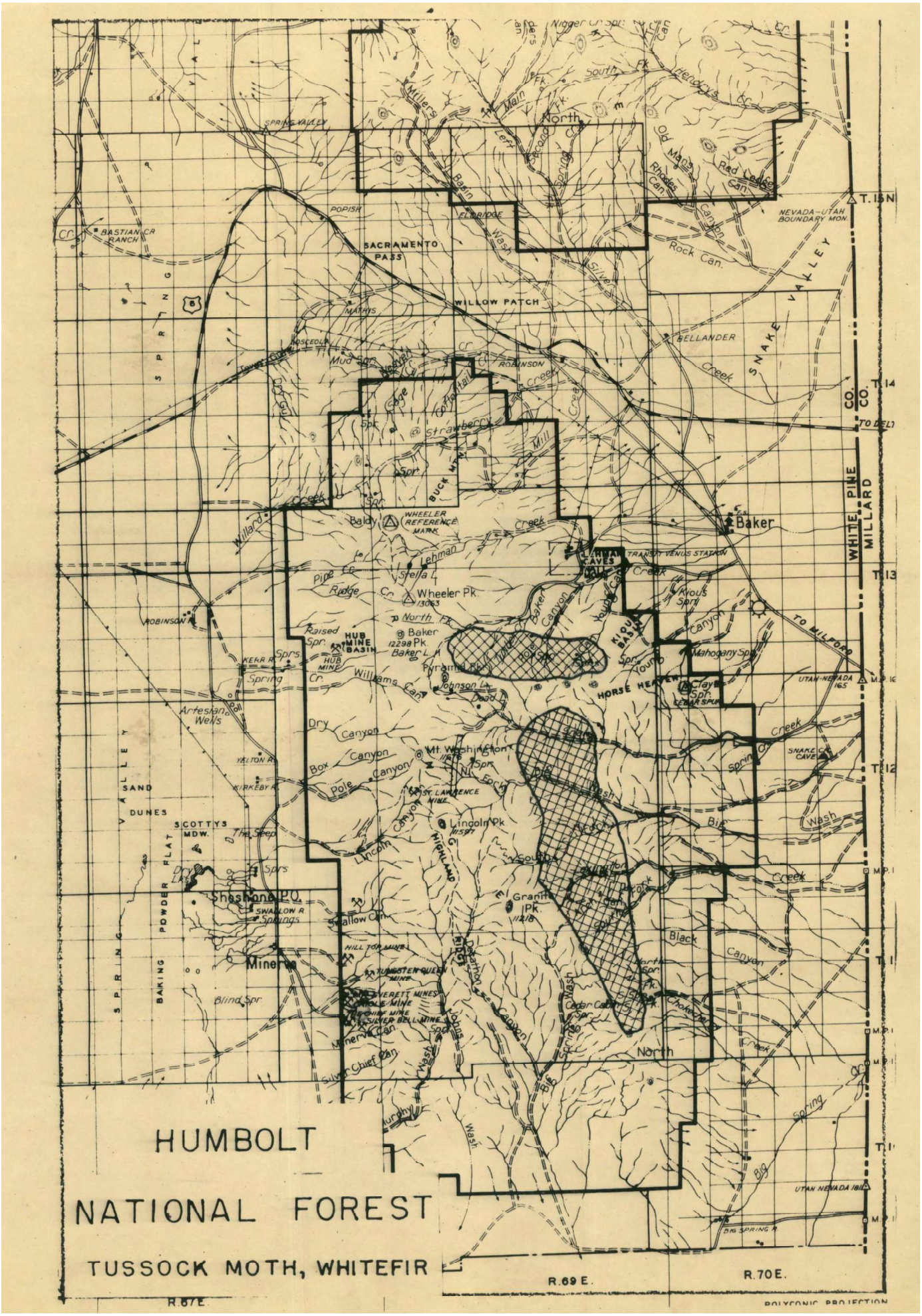

TARGHEE
NATIONAL FOREST
SPRUCE BUDWORM
T.12 S.
T.13 S.
T.14 S.
T.15 S.
R.1W.
MONTANA PRINCIPAL MERIDIAN
BOISE MERIDIAN T.14N.
BEAVERHEAD
MADISON
GALLATIN
NATIONAL FOREST
MIGRATORY BIRD REFUGE
MONTANA
IDAHO
Cliff Lake P.O.
Sheep Mtn.
Coffin Mtn.
Coffin Lakes
Block Mtn.
Elk Mtn.
Saddle Mtn.
Arrowhead Mtn.
Red Rock Mtn.
Sawtelle Pk.
Jefferson
Reas Pk.
Arange Pk.
Big Springs
Trude Siding
Yellowstone
West Yellowstone
Mt Two Top
Lionhead
Targhee Pk.
Reynolds Pass
Targhee Pass
Red Rock Pass
Boot Jack Pass
Continental Divide
Madison Mountains
Horn Mtns.
Henrys Lake
Upper Red Rock Lake
Swan Lake
Alaska Basin
Sheep Mtn. Basin
Rocker Basin
Moose Creek Plateau
Big Springs Lookout Tower
Flat Rock Ranch
Flat Rock Club
Coffee Pot Rapids
Sheridan R.R. Ranch
Sheridan Resvr.
Lionhead Lodge
Sunset Lodge
Valley View
Timber
Reab Pass
Snowshoe Cabin
Yellowstone R.S.
Madison R.S.
Basin R.S.
Targhee R.S.
Montana R.S.
M.P.25
M.P.20
M.P.15
M.P.10
To Butte
Old Post No. 10
Madison Co.
Beaverhead Co.
Clark Co.
Fremont Co.
Gallatin Co.

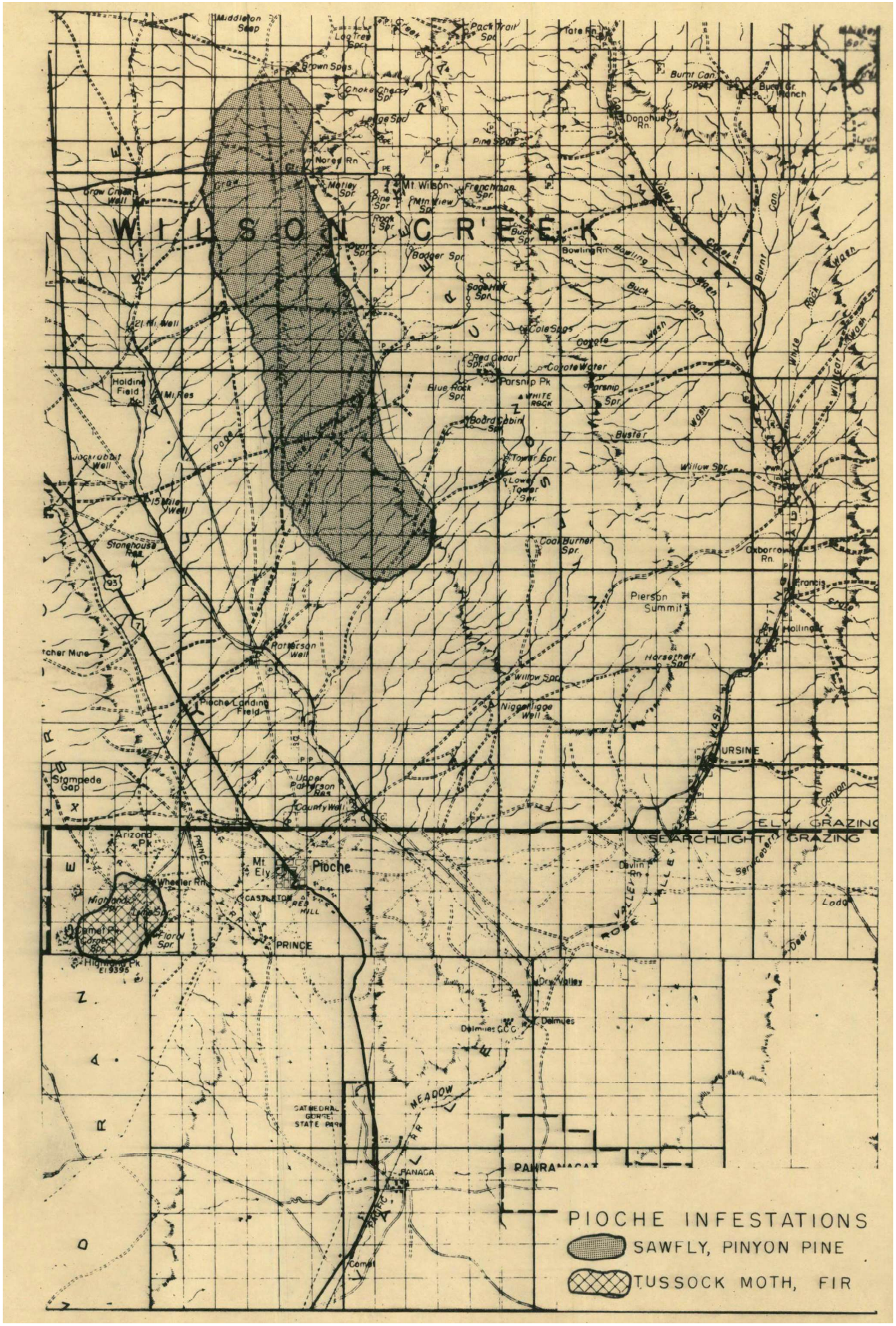
# BOISE

# NATIONAL FOREST

## TUSSOCK MOTH, CEANOTHUS




HUMBOLT
NATIONAL FOREST
TUSSOCK MOTH, WHITEFIR
R.67E.
R.69E.
R.70E.
T.15N
T.14
T.13
T.12
T.11
T.11
POLYCONIC PROJECTION
SPRING VALLEY
SACRAMENTO PASS
WILLOW PATCH
BUCK MT.
SNAKE VALLEY
BELLANDER
ROBINSON
Baker
WHEELER REFERENCE MARK
Wheeler Pk. 13063
Baker 12298 Pk.
Lehman
Stella L.
Baker L.
TRANSIT VENUS STATION
LEHMAN CAVES
WHITE PINE
MILLARD
CO.
CO.
TO DELTA
TO MILFORD
HUB MINE BASIN
HUB MINE
KEHR R.
ROBINSON
Raised Spr.
Spring Cr.
Williams Can.
Artesian Well
YELTON R.
KIRKEBY R.
SAND DUNES
SCOTTYS MDW.
The Seep
Dry Lake
Shoshone P.O.
SWALLOW R. Springs
Swallow Can.
Minerva
Blind Spr.
HILL TOP MINE
TUNGSTEN QUEEN MINE
EVERETT MINES
SILVER BELL MINE
Silver Chief Can.
Aurthur Wash
Dry Canyon
Box Canyon
Pole Canyon
Lincoln Canyon
Mt. Washington 11,813
ST. LAWRENCE MINE
Lincoln Pk 11597
HIGHLAND RIDGE
Granite Pk 11218
Big Wash
Black Canyon
Cedar Canyon
Chokecherry Spr.
Mahogany Spr.
Kious Spr.
Kious Basin
Young Spr.
Clay Spr.
CEDAR SPUR
HORSE HEAVEN
UTAH-NEVADA 165
UTAH NEVADA 181
SNAKE CR. CAVE
BIG SPRING
NEVADA-UTAH BOUNDARY MON.
BASTIAN CR. RANCH
POPISH
ELDRIDGE
Miller's Fk.
Main Fk.
South Fk.
North Fk.
Second Spring Can.
Old Man Rhodes Can.
Red Ledge Can.
Rock Can.
Silver Can.
Nigger Cr. Spr.
Mud Spr.
Strawberry Spr.
Mill Creek
Dry Gulch
Pipe Cr.
Ridge Cr.
Baker Canyon
Young Can.
Spring Cr.
Spr.
Creek
Wash
Canyon
Can.
Fk.
Spr.
Cr.

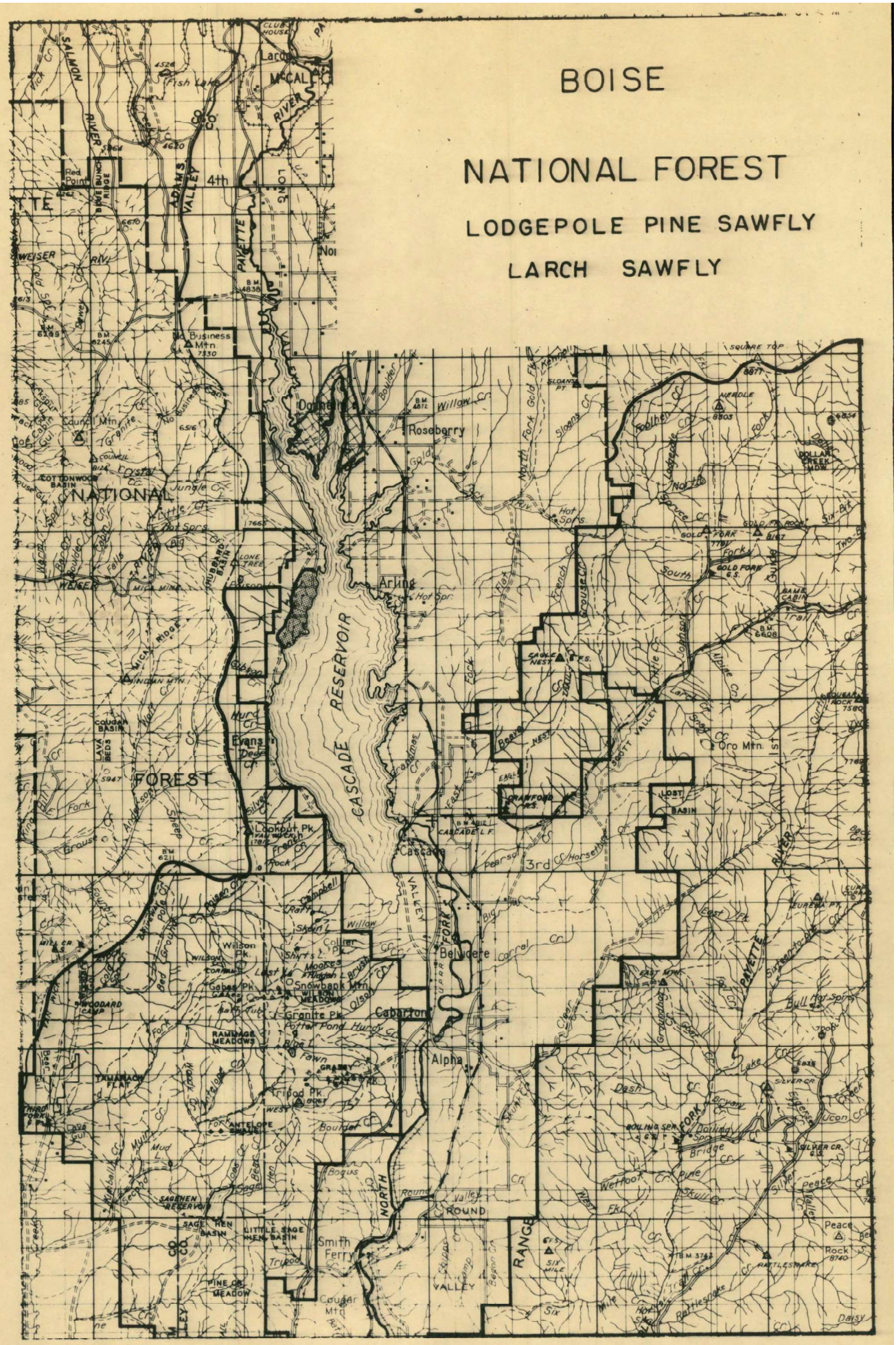

WILSON CREEK
Middleton Seep
Log Tree Spr.
Brown Spgs.
Choke Cherry Spr.
Log Spr.
Pine Spr.
Norey Rn.
Pack Trail Spr.
Tate Rn.
Burnt Can. Spgs.
Buck Gr. Ranch
Donohue Rn.
Grow Creek Well
Mattley Spr.
Mt. Wilson
Pine Spr.
Mtn. View Spr.
Frenchman Spr.
Rock Spr.
Buck Spr.
Sagebrush Spr.
Badger Spr.
Bowling Rn.
Bowling Creek
Burnt Can.
Buck Wash
Green Rock Wash
White Rock Wash
Willow Creek
21 Mi. Well
Cole Spgs.
Coyote Wash
Coyote
Red Cedar Spr.
Coyote Water
Holding Field
21 Mi. Res.
Blue Rock Spr.
Parsnip Pk.
WHITE ROCK
Parsnip Spr.
Board Cabin Spr.
Buster Wash
Buster
Tower Spr.
Lower Tower Spr.
Willow Spr.
Poor Wash
Workabout Well
15 Mile Well
Stonehouse Rn.
Cook Burner Spr.
Oxborrow Rn.
Francis Creek
Pierson Summit
Roy Hollingsr.
Patterson Well
Horsethief Spr.
Willow Spr.
Nigger Nigger Well
Pioche Landing Field
URSINE
Stampede Gap
Upper Patterson Res.
County Well
Arizona Pk.
Mt. Ely
Pioche
Wheeler Rn.
Highland Pk.
Lake Spr.
Hammet Pk.
Campbell Spr.
Fiord Spr.
CASTLETON
RED HILL
PRINCE
Highland Pk. El. 9395
Prince Wash
Davlin Rn.
Lodge Canyon
Deer Canyon
SEARCHLIGHT GRAZING
ELY GRAZING
ROBY VALLEY
Dry Valley
Delmues
Delmues G.C.C.
CATHEDRAL GORGE STATE PARK
MEADOW VALLEY WASH
PANACA
PAHRANAGAT
Comet
PIOCHE INFESTATIONS
SAWFLY, PINYON PINE
TUSSOCK MOTH, FIR

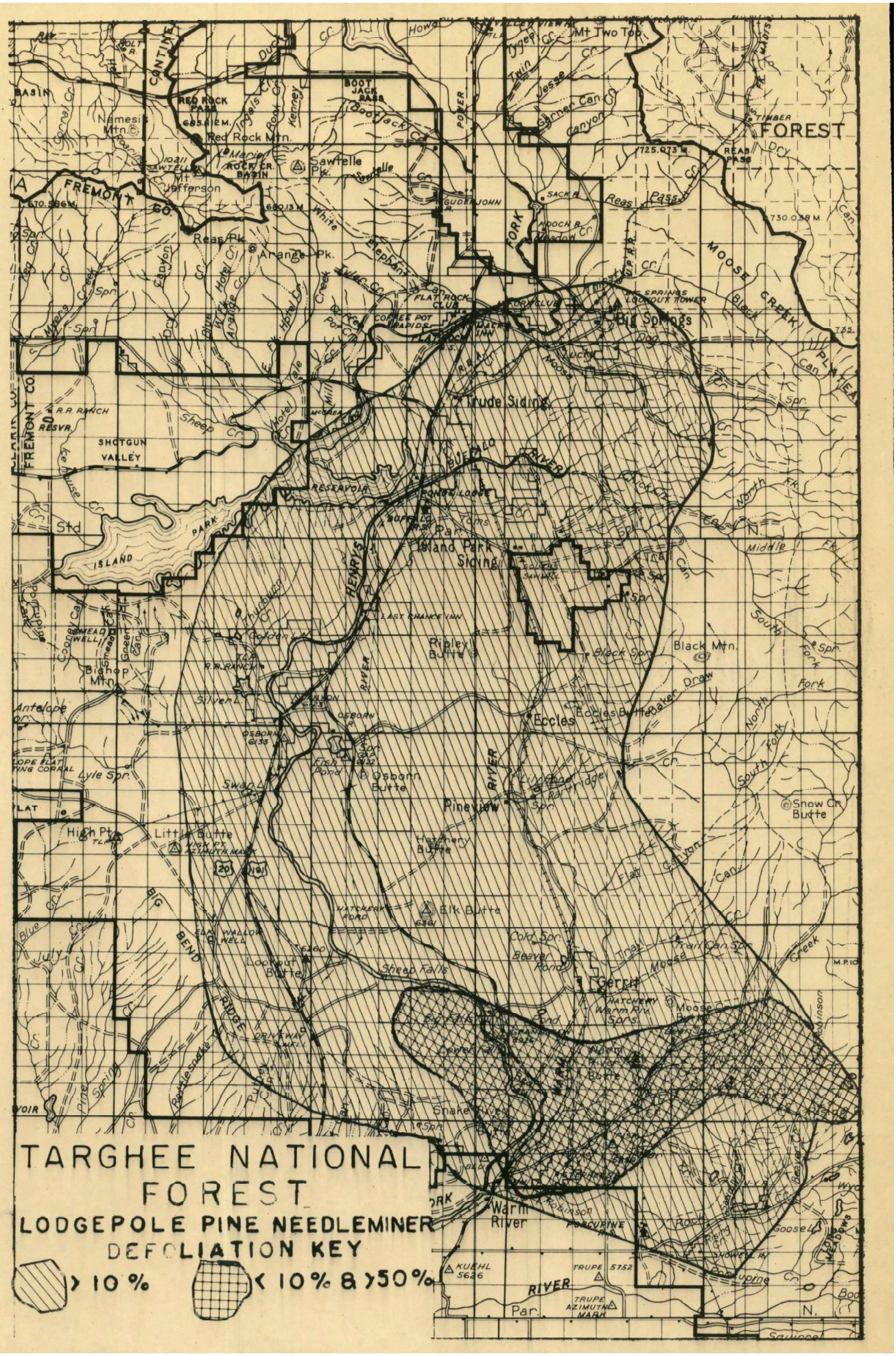
# BOISE

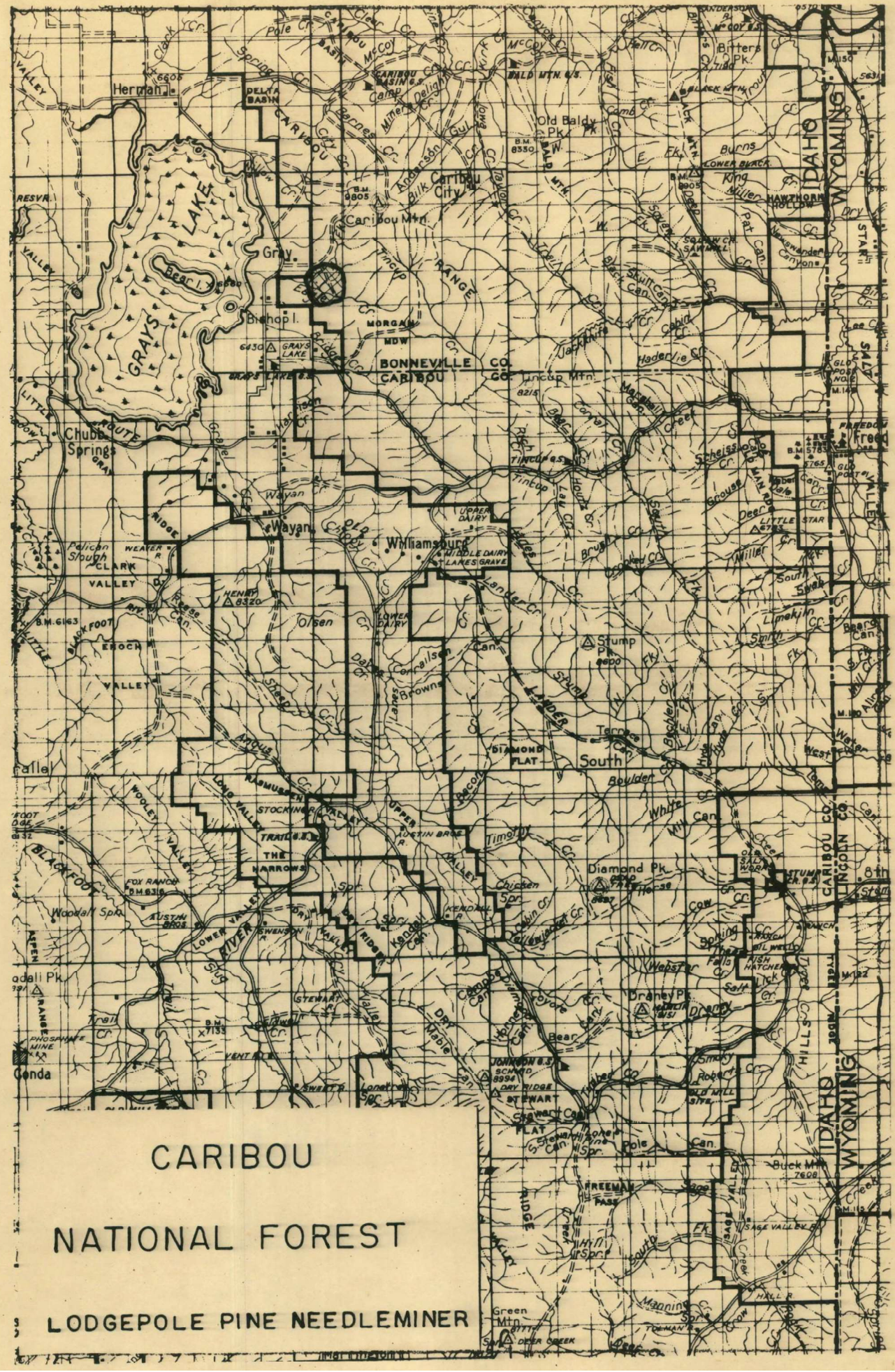
# NATIONAL FOREST

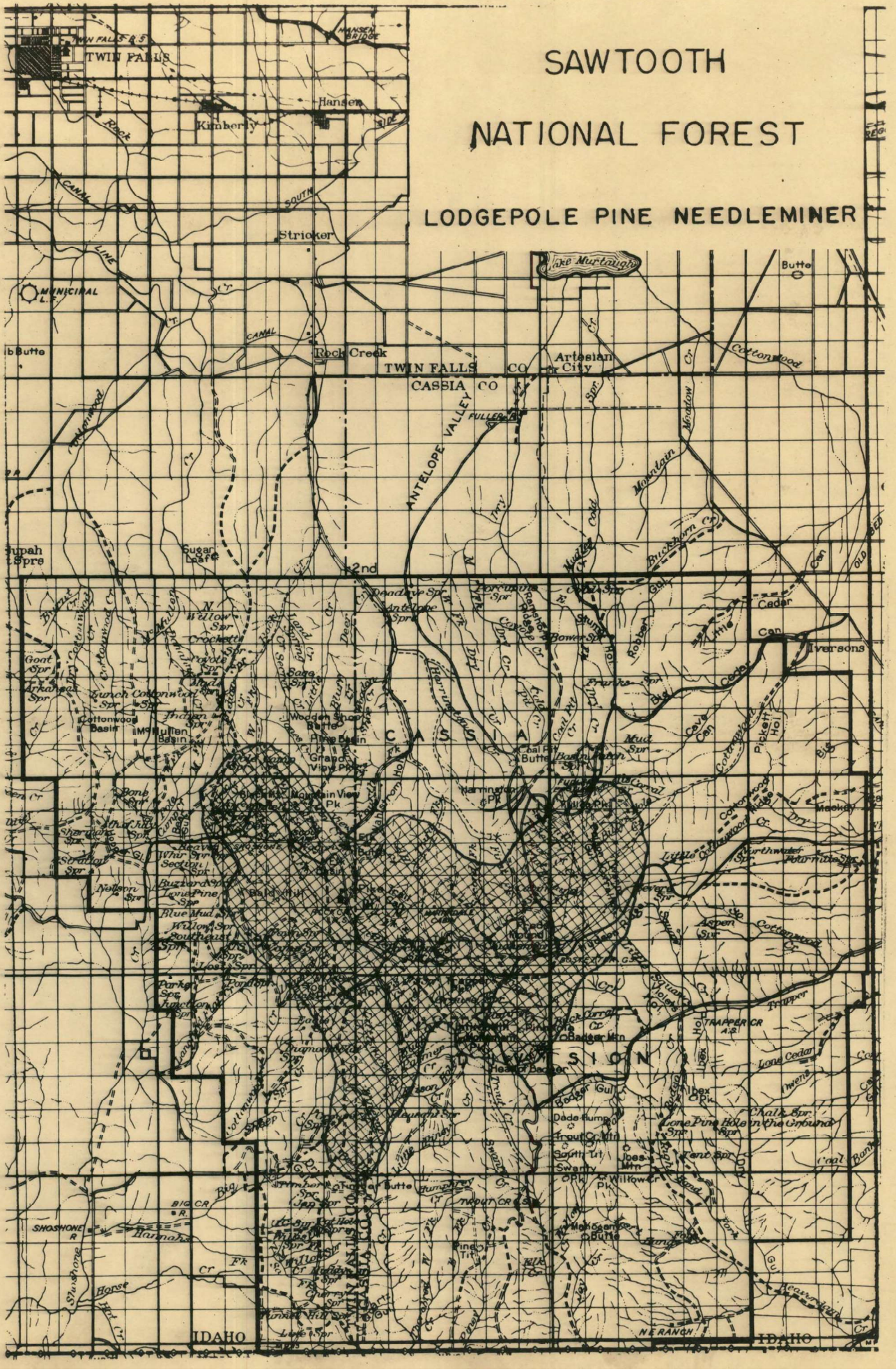
## LODGEPOLE PINE SAWFLY

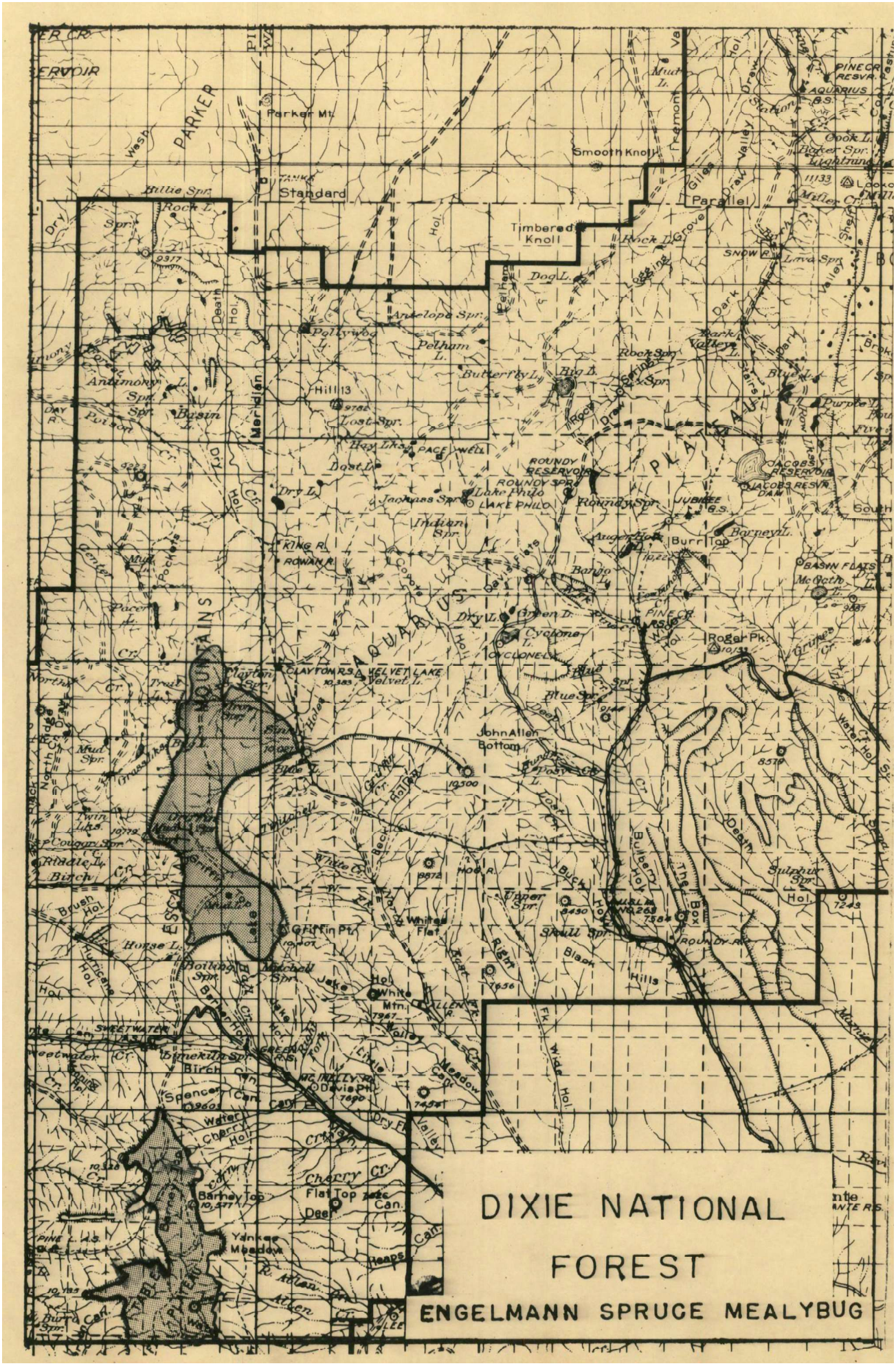
## LARCH SAWFLY

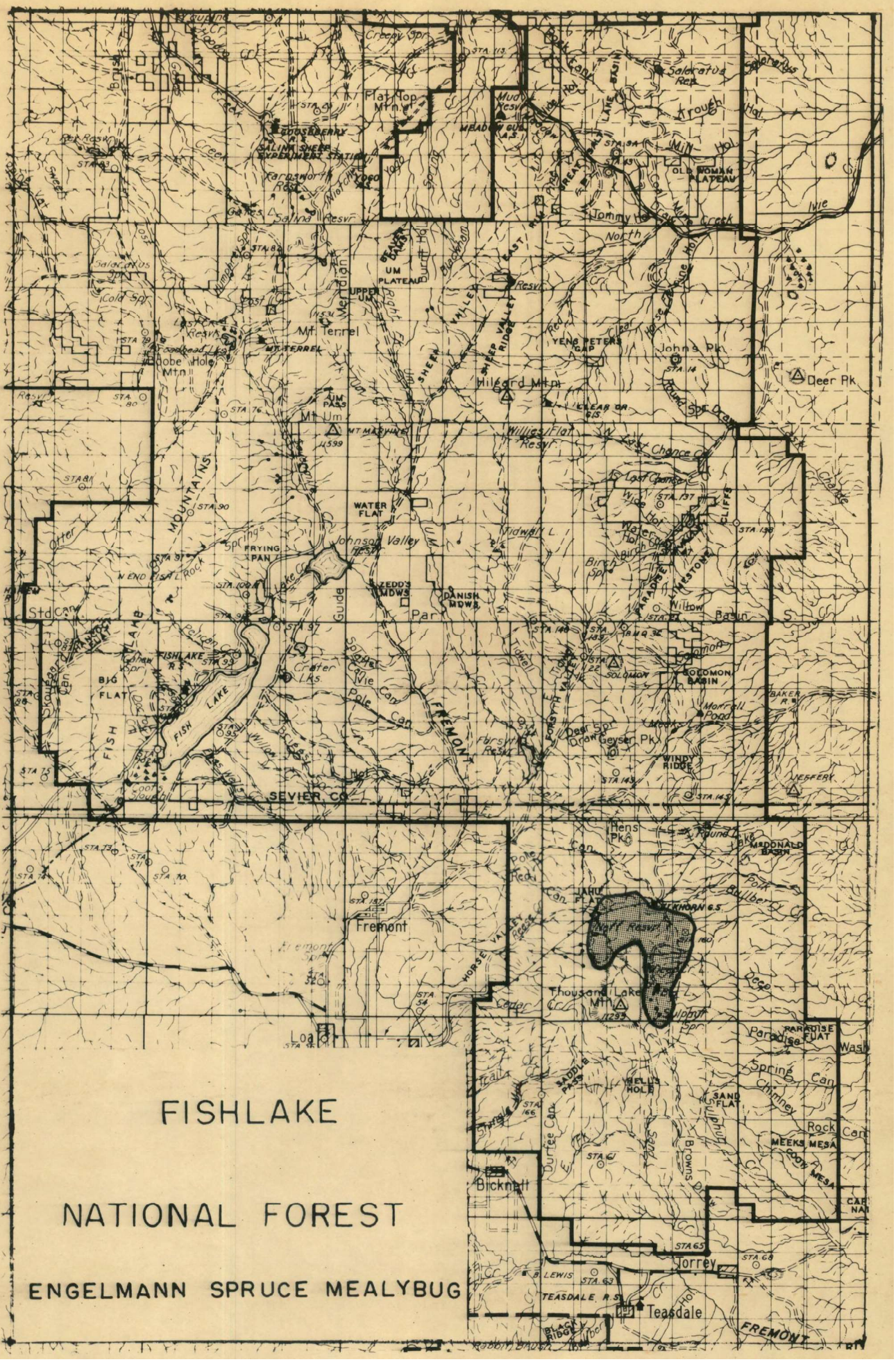


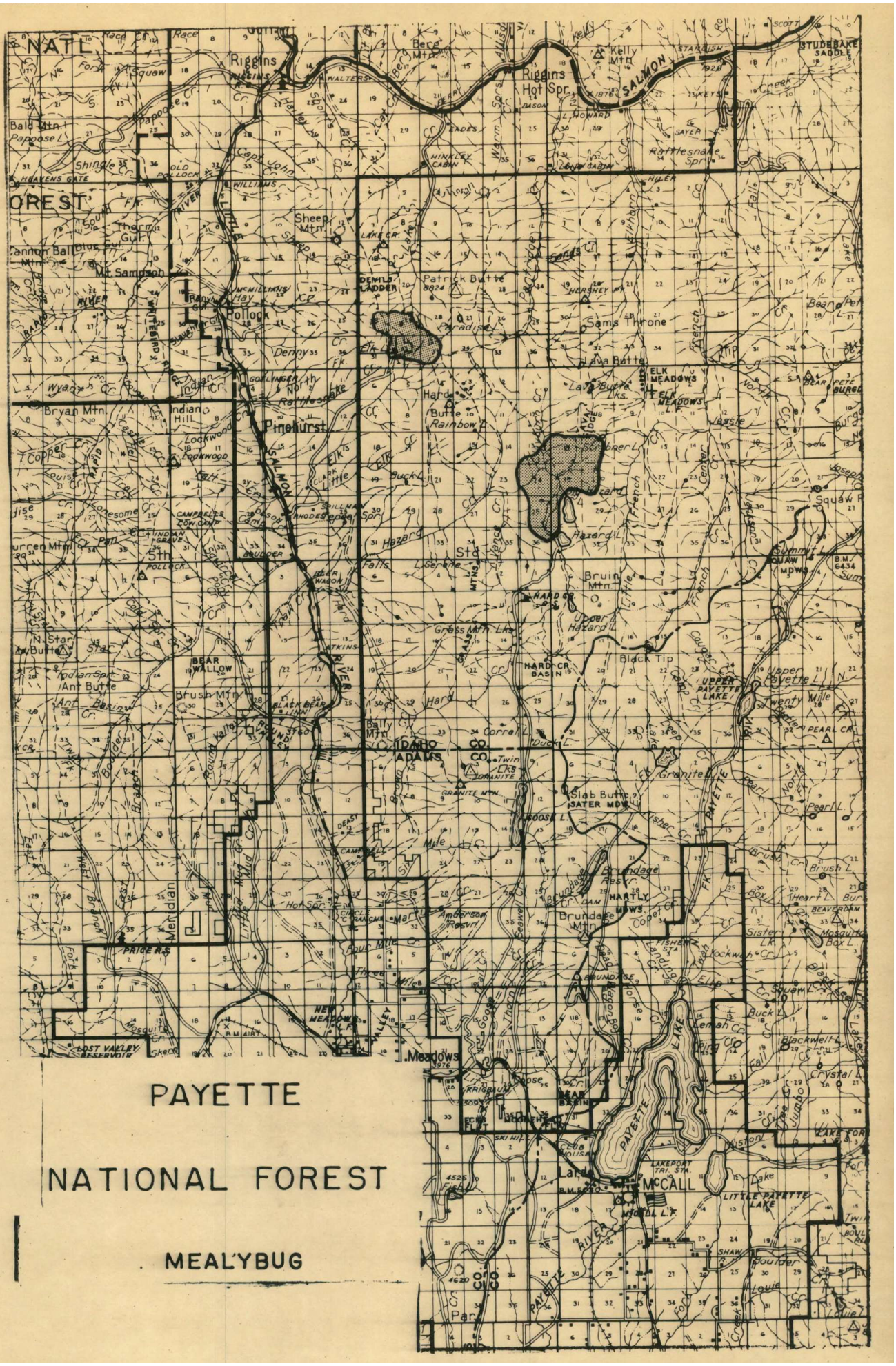

TARGHEE NATIONAL FOREST
LODGEPOLE PINE NEEDLEMINER
DEFOLIATION KEY
> 10 %
< 10 % & >50 %
FOREST
FREMONT CO.
Big Springs
Trude Siding
Island Park Siding
Ashton
Eccles
Pinelew
Gerrit
Warm River
Mt Two Top
Red Rock Mtn.
Sawtelle Pk.
Mt Jefferson
Reas Pk.
Arange Pk.
Namesi Mtn.
Bishop Mtn.
Ribley Butte
Osborn Butte
Little Butte
Elk Butte
Black Mtn.
Snow Cr Butte
Lookout Butte
Sheep Falls
Hatchery Butte
Moose Butte
Warm Rm Butte
SHOTGUN VALLEY
ISLAND PARK
BUFFALO RIVER
HENRYS FORK
SNAKE RIVER
BIG BEND
MOOSE CREEK
PLATEAU
FLAT ROCK CLUB
LAST CHANCE INN
SPRINGS LOOKOUT TOWER
RED ROCK PASS
BOOT JACK BASIN
ROCK CR. BASIN
SACK A MOOCH B MEADOW
REAS PASS
TRUPE 5752
KUEHL 5626
TRUPE AZIMUTH MARK
OSBORN 6135
ELK BUTTE 6161
LOOKOUT BUTTE 6260
HIGH PT. AZIMUTH MARK
SHOWER FALLS
Par.
N.


CARIBOU
NATIONAL FOREST
LODGEPOLE PINE NEEDLEMINER


SAWTOOTH
NATIONAL FOREST
LODGEPOLE PINE NEEDLEMINER
TWIN FALLS
Hansen
Kimberly
Stricker
Lake Murtaugh
Butte
Rock Creek
TWIN FALLS CO
CASSIA CO
Artesian City
ANTELOPE VALLEY
Cottonwood
Meadow
Sugar Loaf
2nd
Cedar
Iversons
Mud Spr
Harrington Pk
Mountain View Pk
Trapper
Long Cedar
Chalk Spr.
Dead Horse
Trout Cr Mtn
Joes Mtn
Willow Pk
Pine Tree
Horse Heaven
Hamaha
SHOSHONE
BIG CR
IDAHO
NE RANCH
IDAHO


DIXIE NATIONAL
FOREST
ENGELMANN SPRUCE MEALYBUG
PARKER
Parker Mt.
Standard
Parallel
Timbered Knoll
Smooth Knoll
Dog L.
Pelham L.
Butterfly L.
Big L.
Hill 13
Lost Spr.
Basin
Dark Valley
Purple L.
PLATEAU
ROUNDY RESERVOIR
ROUNDY SPR.
LAKE PHILO
JACOBS RESERVOIR
JACOBS RESVR. DAM
JUBILEE G.S.
Indian Spr.
Burr Top
Barney L.
Augerhole
BASIN FLATS
McGath L.
Bango L.
Dry L.
Green D.
Cyclone L.
CYCLONE L.
PINE CR. RESVR.
Rogar Pk.
CLAYTON RS.
HELVEN LAKE
Velvet L.
Clayton Spr.
John Allen Bottom
Twin Lks.
Riddle L.
Birch Cr.
Brush Hol.
Horse L.
Hurricane Hol.
Bollibokka Spr.
Mitchell Spr.
Upper Spr.
Skull Spr.
Whites Flat
GRIFFIN PK.
White Mtn.
Hills
SWEETWATER
Birmekiln Spr.
Spencer
Water Cherry Hol.
Cherry Cr.
Flat Top
Barney Top
Yankee Meadow
Meadow Can.
Deep Can.
Heaps
Allen Fk.
Allen Cr.
Pine L.
Burro Cr. Spr.
Sulphur Spr.
Death Hol.
Bulberry Hol.
The Box
Black Hills
Wide Hol.
Valley
Lava Spr.
Rock Spr.
Rock Dr.
Grove
Gilles Draw
Skatoon Draw
Lightning
Cook L.
Parker Spr.
Meller Cr.
Dry Spr.
Rock L.
Wasp
Death Hol.
Meridian
Antimony L.
Antimony Spr.
Poison
Dry L.
Dust L.
Hay Lake
PACE WELL
Jackass Spr.
Mud L.
Pace L.
Trail L.
Mud Spr.
Twin Lks. Spr.
Cougar Spr.
Riddle L.
Birch Cr.
Brush Hol.
Horse L.
Hurricane Hol.
Bollibokka Spr.
Mitchell Spr.
Jake Hol.
Sweetwater Cr.


FISHLAKE
NATIONAL FOREST
ENGELMANN SPRUCE MEALYBUG


PAYETTE
NATIONAL FOREST
MEALYBUG